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[54] **ELECTRONIC SOURCING SYSTEM**

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[51] **Int. Cl.**[7] **G06F 17/60**

[52] **U.S. Cl.** **705/27**; 705/26; 701/1; 701/10; 701/104

[58] **Field of Search** 705/1, 26, 27; 707/1, 10, 100, 104

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,135,241	1/1979	Stanis et al.	364/200
4,141,078	2/1979	Bridges, Jr. et al.	364/900
4,336,589	6/1982	Smith et al.	364/403
4,509,123	4/1985	Vereen	364/300
4,636,950	1/1987	Caswell et al.	364/403
4,656,591	4/1987	Goldberg	364/478
4,887,208	12/1989	Schneider et al.	364/403
4,897,867	1/1990	Foster et al.	379/94
4,920,488	4/1990	Filley	364/403
4,958,280	9/1990	Pauly et al.	364/403
4,972,318	11/1990	Brown et al.	364/403
4,984,155	1/1991	Geier et al.	364/401
4,992,940	2/1991	Dworkin	364/401
5,038,283	8/1991	Caveney	364/403
5,077,665	12/1991	Silverman et al.	364/408
5,101,352	3/1992	Rembert	364/401
5,103,079	4/1992	Barakai et al.	235/380
5,117,354	5/1992	Long et al.	364/401
5,168,444	12/1992	Cukor et al.	364/401
5,168,445	12/1992	Kawashima et al.	364/403
5,305,199	4/1994	LoBiondo et al.	364/403
5,319,542	6/1994	King, Jr. et al.	364/401
5,758,327	5/1998	Gardner et al.	705/26
5,778,355	7/1998	Boyer et al.	707/2
5,799,289	8/1998	Gukushima et al.	705/400

FOREIGN PATENT DOCUMENTS

0 697 669 A2	8/1995	European Pat. Off. .
WO 90/11572	10/1990	WIPO .

OTHER PUBLICATIONS

European Search Report, Application No. 95 305364, Dated Aug. 2, 1997.

"Texas Instruments Puts the MRO Buy On Line," *Purchasing*, p. 37, May 19, 1994.

"IBM Technical Viewer/2 General Information Manual," IBM Corporation, 1991.

"IBM Technical Viewer/2" product information brochure, IBM Corporation, undated.

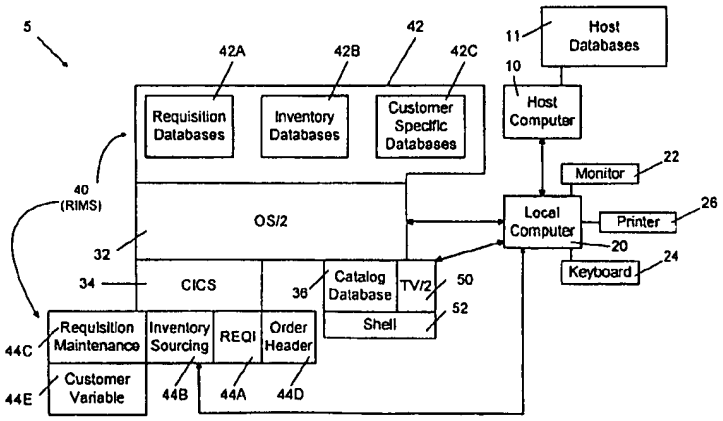
(List continued on next page.)

Primary Examiner—Edward R. Cosimano
Attorney, Agent, or Firm—Rader, Fishman & Grauer PLLC

[57] **ABSTRACT**

An electronic sourcing system includes a computer that maintains a catalog database of data including product information (such as product identification and descriptive information) relating to catalog items available from vendor product catalogs, and a means for building (generating) a requisition including at least one requisitioned item. Information at least partially identifying an item desired to be requisitioned is entered by a user, and utilized by a means for searching the database for catalog items matching that information and for selecting at least one catalog item located as a result of the search. Text describing the catalog items, and images of the items, may be viewed. Data identifying selected catalog items are communicated to the requisition building means, which generates a requisition including entries for items corresponding to the selected catalog items. The system checks the availability in one or more inventory locations of the corresponding desired catalog items, and generates one or more purchase orders for desired items from inventory locations stocking the items.

29 Claims, 5 Drawing Sheets



OTHER PUBLICATIONS

"Guide to Using First Place," Automated Catalogue Services Inc., Aug. 1993.
"Grainger Electronic Catalog User's Guide," Edition 6, pp. 29–33 and 49–50, 1994.
"Automated Catalog Systems" product information brochure, Distrivision Development Corporation, 1994.
"SweetSource User's Guide," Sweet's Electronic Publishing, Mar. 1, 1993.
"Aldrich Catalog on Disk Reference Manual," Aldrich Chemical Company, Inc., 1994.
"Easel to Move Development to Windows," *Infoworld*, May 16, 1994.
"Easel Eases the Way to 00," *Computer Select*, Jun. 1994.
"Stockclerk Inventory Management System" product information brochure, IOBar, Inc., 1993.
"Fisher StockPro™ Inventory Management System" brochure, Fisher Scientific, 1990.
"Systems by Fisher/Inventory Management System/StockPro®—Single–User Version" user manual, pp. 6–1 to 6–14, 6–21 to 6–26, 7–1 to 7–18, 8–1 to 8–20, 9–1 to 9–6, and 10–1 to 10–8, Fisher Scientific Company, Feb. 28, 1989.
"Fisher Scientific PurchasePro" user manual, version 1.1., Introduction pp. 1–6, File Editor pp. 1–12, Purchase Requisitions pp. 1–12, Purchase Orders pp. 1–8, 23, and 34, Vendor Quotes p. 1, Fastback Orders pp. 1–8, Reports p. 1, ReportPro p. 1, 1984.
"Lightning™ Fisher's Electronic Order Entry System" brochure, Fisher Scientific Company, 1989.
"Lightning™ Order Entry and Information System" user manual, pp. 1–6, 19–54, and 91–96, Fisher Scientific Company, 1990.
"Fisher Reliance™ System" brochure, Fisher Scientific Company, 1989.
"*Fisher 88*" catalog, pp. 1536, 1549–1567, Fisher Scientific Company, 1987.
Excerpt from "A Prism Electronic Catalog Proposal: Product Information System for Sales and Marketing," prepared by Fisher Scientific Company, presented by MediaShare Corporation, Aug. 31, 1993.

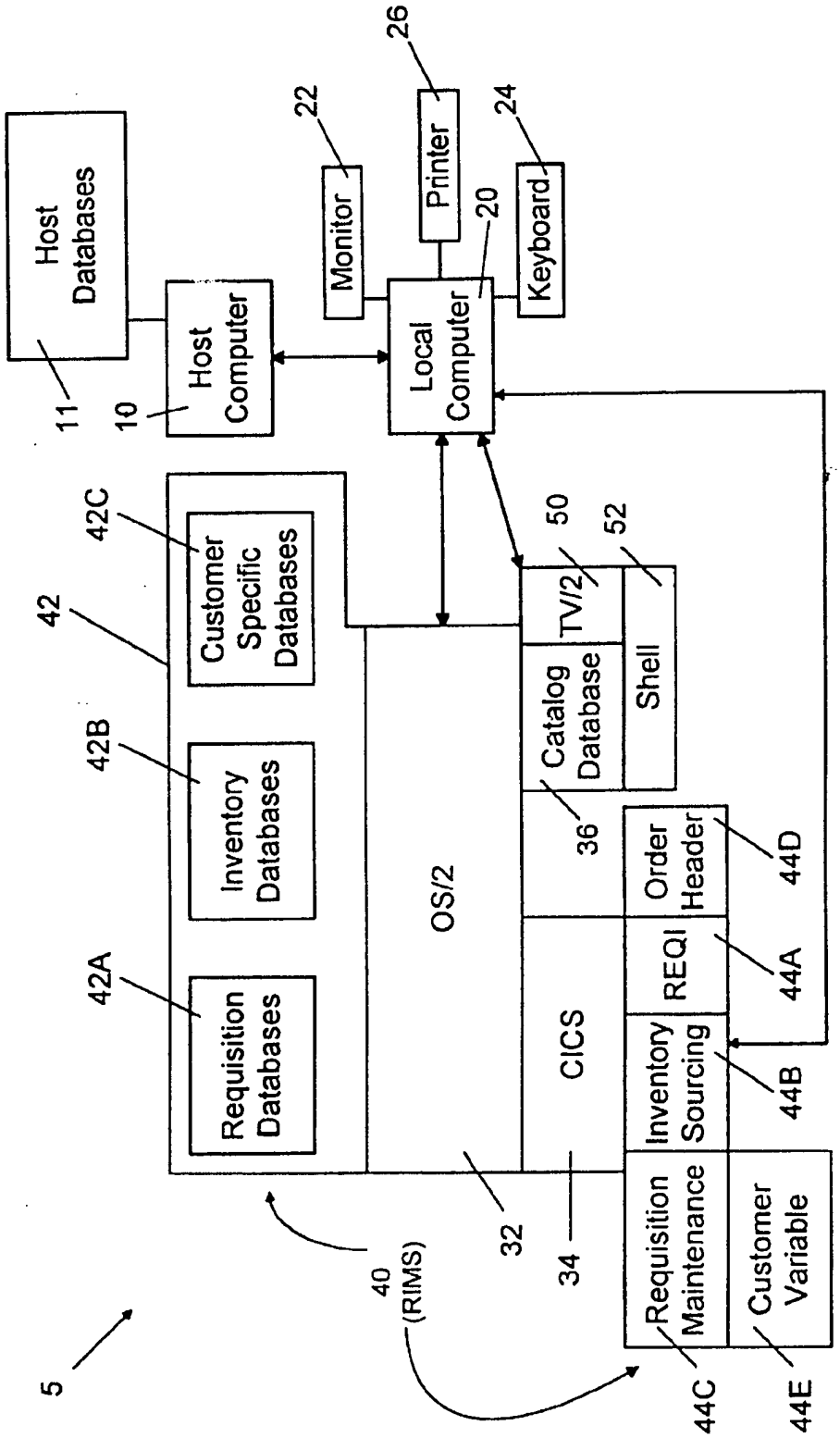

Host Databases
11
Host Computer
10
Monitor
22
Printer
26
Keyboard
24
Local Computer
20
42C
Customer Specific Databases
42
42B
Inventory Databases
42A
Requisition Databases
OS/2
TV/2
50
52
Catalog Database
Shell
36
CICS
Order Header
44D
REQI
44A
Inventory Sourcing
44B
Requisition Maintenance
44C
Customer Variable
44E
40
(RIMS)
32
34
5

FIG. 1A

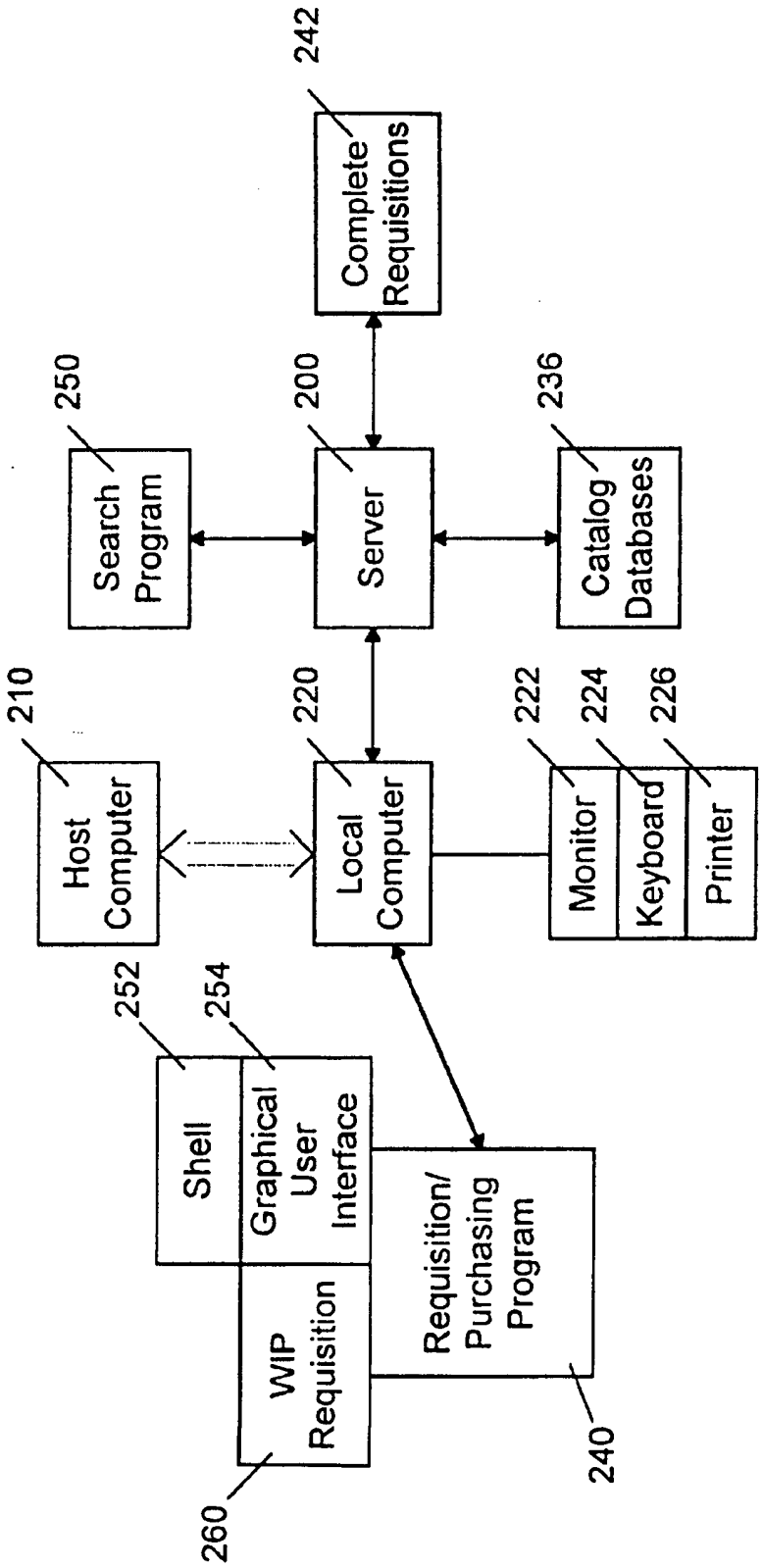
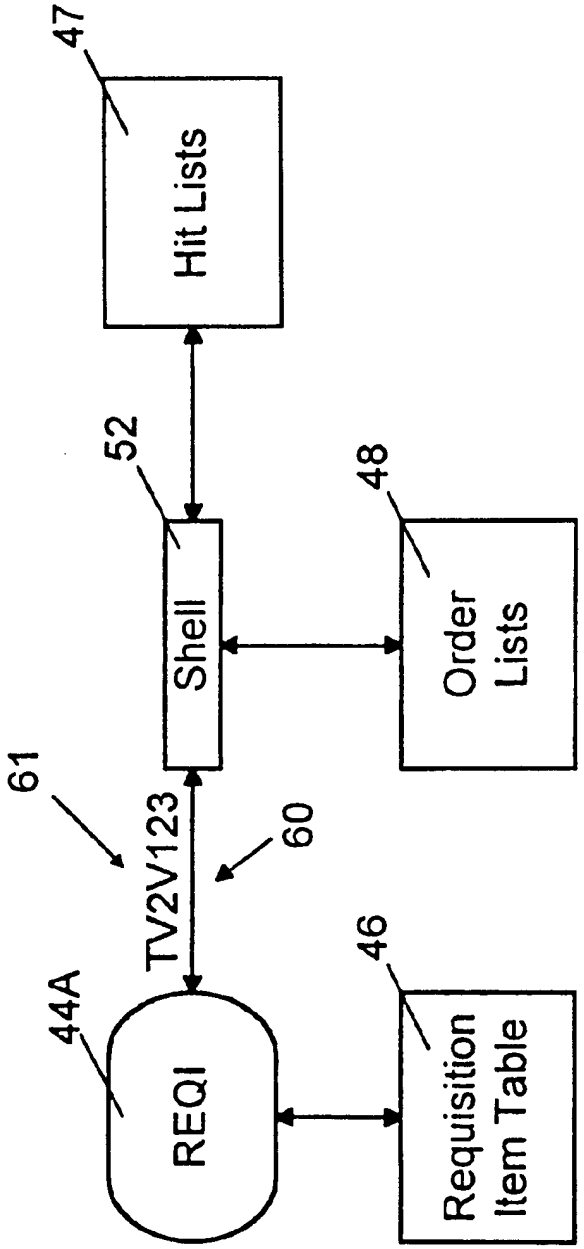

242
Complete Requisitions
250
200
236
Search Program
Server
Catalog Databases
210
220
222
224
226
Host Computer
Local Computer
Monitor
Keyboard
Printer
252
254
Shell
Graphical User Interface
Requisition/ Purchasing Program
WIP Requisition
240
260

FIG. 1B

FIG. 1C


47
Hit Lists
52
48
Shell
Order Lists
61
TV2V123
60
46
44A
REQI
Requisition Item Table

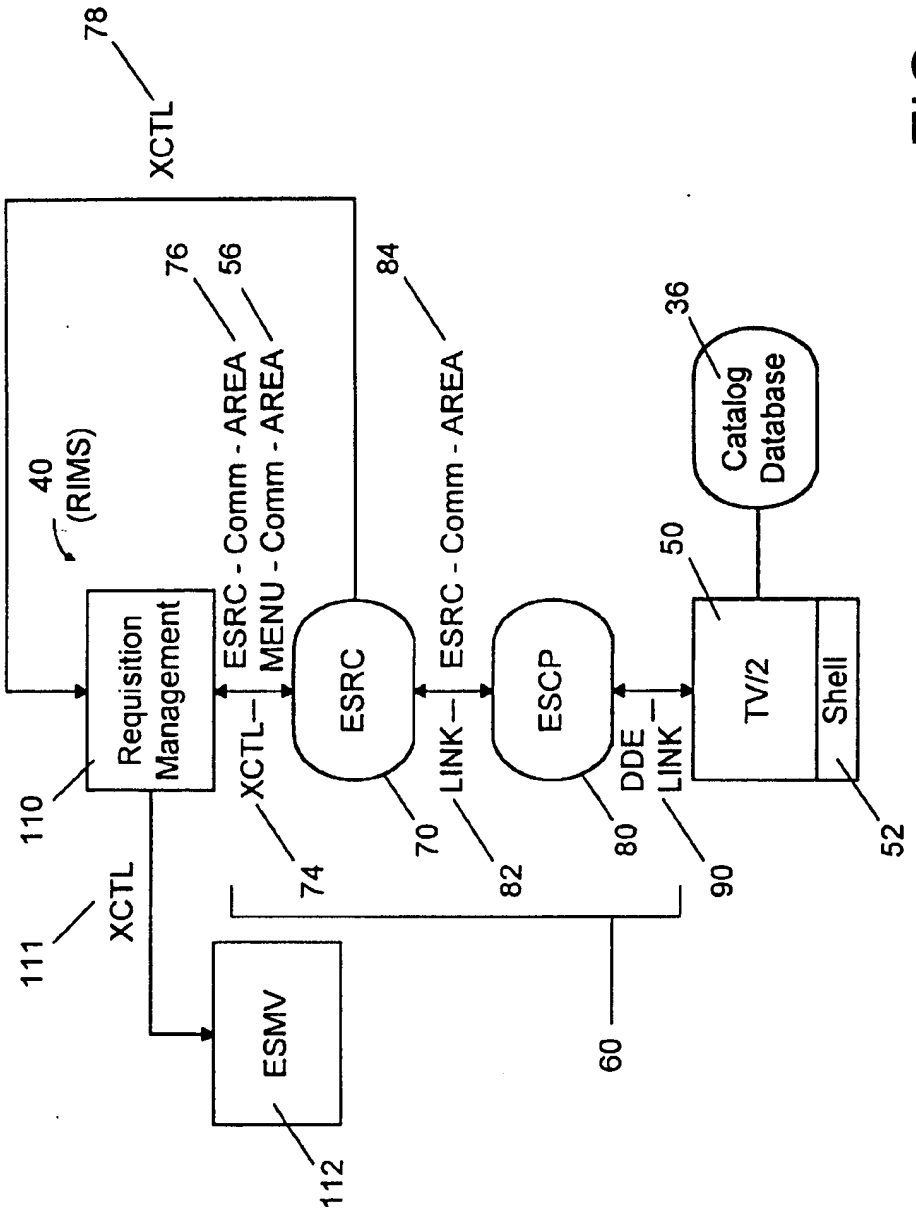

78
XCTL
40
(RIMS)
76
56
ESRC - Comm - AREA
MENU - Comm - AREA
84
ESRC - Comm - AREA
36
Catalog Database
50
Requisition Management
ESRC
ESCP
TV/2
Shell
110
XCTL
74
LINK
70
82
DDE
LINK
80
90
52
111
XCTL
ESMV
112
60

FIG. 2

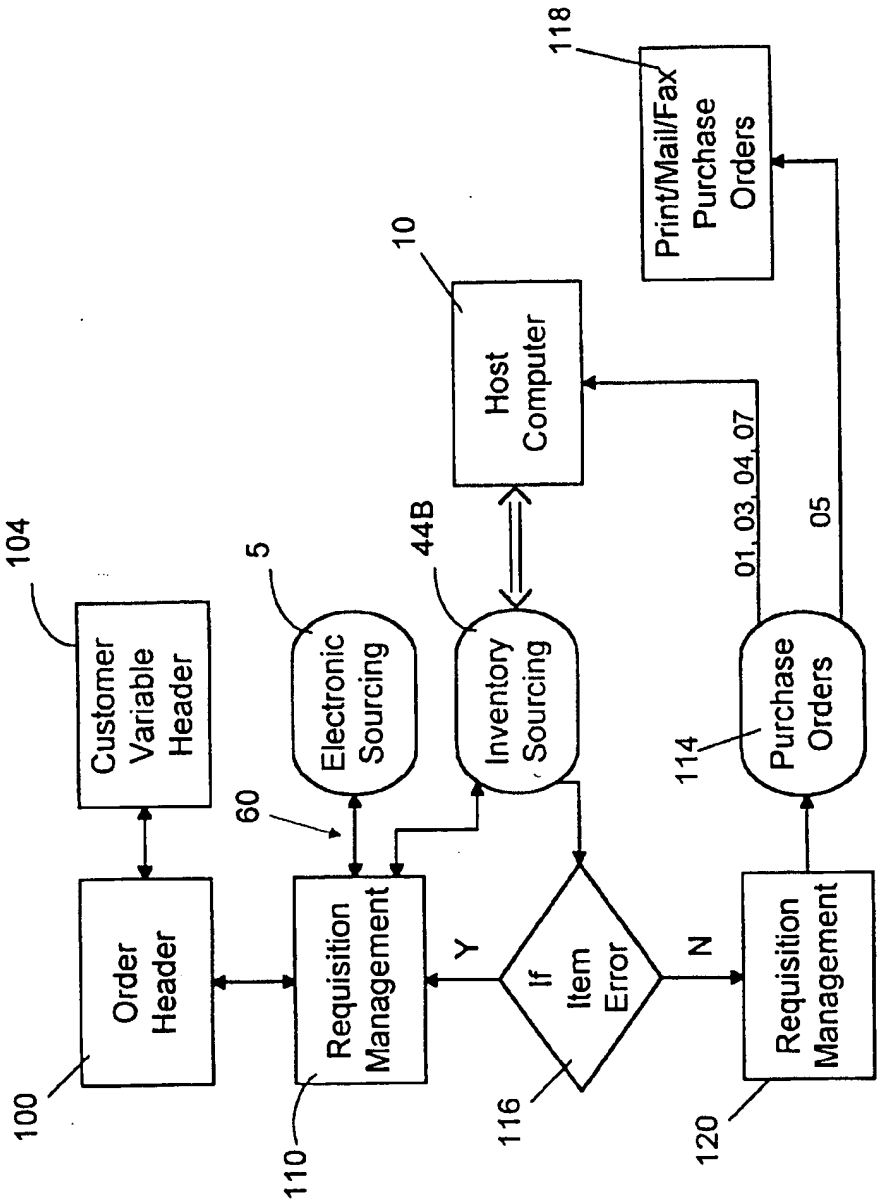

Print/Mail/Fax Purchase Orders
118
Host Computer
10
01, 03, 04, 07
05
Customer Variable Header
104
Electronic Sourcing
5
Inventory Sourcing
44B
Purchase Orders
114
60
Order Header
100
Requisition Management
110
Y
If Item Error
116
N
Requisition Management
120

FIG. 3

ELECTRONIC SOURCING SYSTEM

This application is a continuation of U.S. application Ser. No. 08/288,577 filed on Aug. 10, 1994.

BACKGROUND OF THE INVENTION

This invention relates to systems and methods for interfacing product information, such as is typically found in vendor catalogs that are provided to customers, and requisition/purchasing systems and methods that may use the results of searches of product information.

There are a number of known requisition/purchasing systems that manage and process requisitions and purchase orders. One such system is the Fisher Scientific Requisition and Inventory Management System ("Fisher RIMS"), described in co-pending patent application Ser. No. 08/042,168, filed Apr. 2, 1993, issued as U.S. Pat. No. 5,712,989 on Jan. 28, 1998, and assigned to Fisher Scientific Company of Pittsburgh, Pa., the disclosure of which is incorporated herein by reference. As its title suggests, Fisher RIMS can also manage inventory. In the Fisher RIMS system, requisition records are created from a real-time interaction between a host computer (generally a mainframe) and a local computer (generally at a customer site), with each computer using data from its own respective database of inventory in conjunction with information entered by a customer service representative operating the local computer. By accessing its respective database, each computer can build and transmit to the other computer communications blocks of data relating to a particular requisition of an item in inventory (or to the management of the inventory itself). The other computer can then use the received data to continue processing of the requisition. Thus, requisition records are created from a real-time interaction between the host and local computers, with each computer using data from its respective database in conjunction with information entered by a customer service representative operating the local computer.

Other requisition/purchasing systems can be grouped broadly into four classes. First, requisition management systems licensed to corporations purchasing for their own use include ORION software (from Medical Management Systems), ENTERPRISE software (from ESI), and NOVA software (from Johnson & Johnson). Second, there exist systems provided by distributors for transmitting orders to them in proprietary formats. Such systems include QUICKLINK (from Abbott), ASAP system (from Baxter) and LIGHTNING system (from Fisher Scientific). Third, software packages licensed by software developers to customers and/or suppliers enable the transmission of customer purchase orders as EDI purchase orders (in ANSI X.12 format). Examples of such systems include ON-CALL EDI (from TSI International), EDI Express software (from General Electric Information Services) and GETRAN software (from Sterling Software). Fourth, comprehensive business management packages such as REAL WORLD software (from Real World Corporation of Concord, N.H.) and ASK software (from The ASK Group) contain a purchasing module to create replenishment orders when inventoried items fall below restocking points. The same purchasing module can also be used to place spot orders for products keyed in by the customer's purchasing personnel.

None of these known requisition/purchasing systems (including Fisher RIMS), however, provides a capability for a user readily to search for and locate information about the products that may be requisitioned and ordered in connection with the requisition/purchasing system. They also do not provide the capability for a user to search a database containing two or more vendor catalogs, and then to transfer information about the items selected as a result of such searches into a requisition/purchasing system such as Fisher RIMS for building a requisition for the catalog items.

Computer systems that are capable of searching databases containing a product catalog of a particular vendor, for example on CD-ROM, are also known. Such systems can search for user requested information about products and create orders which the user can save, print or, in some cases, facsimile directly to a vendor. The known computer systems for searching vendor catalogs are limited in that only one such vendor catalog is accessible to a user at any given time. They are also limited in that they can only create an order within the particular vendor catalog database. They cannot source items to be requisitioned from a database containing multiple catalogs or interact with a requisition/purchasing system (such as Fisher RIMS) to create a purchase order or orders including the items located from that sourcing operation.

Thus, it would be desirable to provide an electronic sourcing system that provides a means for transferring information between a requisition/purchasing system that may use the results of a search of product information and a means for searching large volumes of product information such as would be included in a vendor product catalog or catalogs.

It would also be desirable to provide such an electronic sourcing system that is capable of searching a database containing at least two vendor product catalogs for product information.

It would further be desirable to provide such an electronic sourcing system that is capable of searching a database of catalog items contain in at least two vendor product catalogs, selecting particular items located, and transferring information about the items selected (for example, a catalog number and a vendor identifier, such as vendor name and/or vendor number) to a requisition/purchasing system for inclusion in a requisition generated by the system.

It would further be desirable to provide an electronic sourcing system that is capable of creating an order list including items located as the result of a catalog database search and transferring that order list of desired catalog items to a requisition/purchasing system for inclusion of the catalog items as entries in a requisition generated by the system.

SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of this invention to provide an electronic sourcing method and system that provides a user with the capability of searching a database containing data (including product/vendor identification, and other product information) relating to items available from at least two vendor product catalogs, and the capability of transferring the product information for desired catalog items obtained as a result of the search to a requisition/purchasing system for use in generating a requisition including entries for the desired catalog items.

It is also an object of this invention to provide an electronic sourcing system that provides a means for bi-directionally transferring information between a requisition/purchasing system that may use the results of a search of such product information, and a means for searching large volumes of product information such as would be included in a vendor product catalog.

It is a further object of this invention to provide an electronic sourcing system capable of creating an order list including desired catalog items located as the result of such a database search, and transferring that order list to a requisition/purchasing system for generating a requisition including entries for the desired catalog items.

In accordance with the invention, an electronic sourcing system and method used by the system are provided. The system includes a computer that maintains a catalog database of data including product information (such as product identification information, and descriptive information) relating to catalog items available from vendor product catalogs, and a means for building (generating) a requisition including at least one requisitioned item. Information at least partially identifying an item desired to be requisitioned is entered by a user, and utilized by a means for searching the database for catalog items matching that information and for selecting at least one catalog item located as a result of the search. Text describing the catalog items, and images of the items, may be viewed. Data identifying selected catalog items are communicated to the requisition building means, which generates a requisition including entries for items corresponding to the selected catalog items. Additionally, the invention includes a means for checking the availability in one or more inventory locations of the corresponding desired catalog items, and for generating one or more purchase orders for desired items from inventory locations stocking the items.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages of the invention will be apparent from consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. 1A is a block diagram showing one exemplary embodiment of the overall system of the present invention;

FIG. 1B is a block diagram showing another exemplary embodiment of the overall system of the present invention;

FIG. 1C is a block diagram showing a portion of the embodiment of FIG. 1A in greater detail;

FIG. 2 is a block diagram showing the flow of control and interaction between the various programs and data screens of the programs used for requisition management and vendor catalog searching of the present invention; and

FIG. 3 is a block diagram showing a portion of a system (Fisher RIMS) for requisition management, including the electronic sourcing system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1A and 1B show preferred embodiments of the electronic sourcing system **5** of the present invention. As shown in FIG. 1A, a local computer **20**, which is preferably located at or near a Customer site and the site of Just-In-Time ("JIT") Inventory, is preferably used by an on-site Customer Service Representative ("CSR") dedicated to a Customer to assist that Customer in requisitioning items needed.

Local computer **20** includes conventional color monitor **22** and alphanumerical keyboard **24** including twelve function keys F1, F2, . . . F12. Local computer **20** is also coupled to printer **26**.

Local computer **20** is preferably a conventional microcomputer (such as a 386-, 486- or Pentium-class personal computer) capable of operating the required programs and of transmitting and receiving the required communications, running the OS/2 operating system **32** and also running the CICS OS/2 application **34**, both of which are available from IBM.

Electronic sourcing system **5** also includes a requisition/purchasing system **40**, preferably but not necessarily the Fisher RIMS system, and a search program **50** that is capable of searching through large volumes of information quickly and accurately. Preferably but not necessarily, the Technical viewer 2 search program ("TV/2"), available from IBM, is used as search program **50**. As shown in the embodiment of FIG. 1A, Fisher RIMS **40** and TV/2 search program **50** are run by local computer **20**.

Fisher RIMS system **40** is comprised of numerous program modules, including several programs **44**, which operate within CICS environment **34** of OS/2 operating system **32**. Programs **44** include, among others, Requisition Management ("REQI") program **44A**, Inventory Sourcing program or programs **44B**, Requisition Maintenance program **44C**, Customer Variable program **44D**, and Order Header program **44E**, each of which will later be described in greater detail. REQI program **44A** is most often the RIMS program **44** that interfaces with TV/2 search program **50**.

Fisher RIMS system **40** also includes several Fisher RIMS databases **42**. These databases **42** preferably include requisition databases **42A**, inventory databases **42B**, and customer-specific databases **42C**, each maintained within OS/2 operating system **32**.

Local computer **20** also preferably runs Shell program **52**, which operates under search program **50** and is used to customize search program **50** to generate Order Lists **48** (shown in FIG. 1C) with particular fields of formatted data about the items selected using search program **50**. Local computer **20** is preferably capable of running both a RIMS program **44** and Shell program **52** at the same time (i.e., in a multi-tasking environment), but the user of local computer **20** usually sees only RIMS program **44** or Shell program **52** at one time in the foreground on monitor **22**.

Local computer **20** is also provided with a catalog database **36** comprised preferably of at least two vendor product catalogs. The catalogs, and hence catalog database **36**, preferably include such information as part number, price, catalog number, vendor name or I.D., and vendor catalog number, as well as textual information and images of or relating to the catalog products. The nature of the business that the Customer using electronic sourcing system **5** conducts will determine which product catalogs are made a part of catalog database **36**.

A feature of the present invention is the ability to search multiple catalogs from different suppliers. For example, catalog database **36** can contain the catalog or catalogs published by a vendor Distributor, having Distributor's catalog numbers for all listed products and vendor manufacturer's part numbers for many of the listed products. Catalog database **36** can further contain catalogs published by some of the vendor manufacturers, listing the manufacturers' part numbers for certain products correspondingly listed in the Distributor's catalogs and for certain products not listed in the Distributor's catalogs. Catalog database **36** can further contain catalogs published by outside suppliers, whether other manufacturers or other distributors, listing such vendor's products different from those in the Distributor's catalogs.

Where the Fisher RIMS system is in use with electronic sourcing system **5**, a host computer **10** located at a Distribu-

tor site is also provided, as shown in FIG. 1A. Host computer **10** controls all inventory, pricing and requisitioning operations of the Distributor's regularly stocked items using host pricing and inventory databases **11**. Host pricing and inventory databases **11** may include such information as: descriptions of the items and the quantities thereof available at a particular Distributor warehouse and at other Distributor warehouses; item records for each Product regularly sold by the Distributor; discount records by Customer; and cross-references from the Distributor's catalog number to its corresponding vendor's part (catalog) number and to similar corresponding catalog numbers of other vendors (suppliers or distributors) for the same Product.

Host computer **10** and local computer **20** are preferably linked point-to-point or in a network employing the formats and protocols of IBM's System Network Architecture ("SNA"). Host computer **10** can be substantially any mainframe or minicomputer capable of running the desired programs and conducting the required communications. Preferably, host computer **10** is a mainframe computer, such as an IBM Model 3090, running the MVS operating system, the MVS-CICS application and a Virtual Telecommunication Access Method communications network.

As shown in FIGS. **1C** and **2**, interface **60** is also a part of electronic sourcing interface system **5**. Interface **60** communicates shared data between requisition/purchasing system **40** and search program **50**. Interface **60** is preferably based upon the dynamic data exchange ("DDE") protocol provided by OS/2 operating system **32**. As shown in FIG. **2**, interface **60** preferably includes three linking programs to interface requisition/purchasing system **40** and search program **50**: ESRC program **70**, ESCP program **80** and DDE LINK **90**.

A typical data exchange may begin with requisition/purchasing system **40** (which, in the illustrated embodiment, is the Fisher RIMS system) requesting information from catalog database **36** via search program **50**. Once a search by search program **50** has been completed, the selected information will be communicated to requisition/purchasing system **40** via interface **60**.

Alternatively, if the search of catalog database **36** is initiated from search program **50**, the information selected from the search is returned to requisition/procurement system **40** via interface **60**.

The start up of electronic sourcing system **5** (FIG. **1A**) may be user-initiated or automatically started when the operating system, preferably OS/2 system **32**, is brought up on local computer **20**. An application-name string **61** must be identified to label interface **60**. As shown in FIG. 1C, electronic sourcing system **5** by convention will use "TV2V123," "TV2V124," "TV2V125," etc. as application names **61** supporting the user's requesting service.

Preferably, application names **61** correspond to virtual terminal sessions that exist in the CICS system **34** of requisition/purchasing system **40**. There will be a one-to-one correspondence between applications started (such as Shell **52**) and CICS virtual terminals in use at a location of requisition/procurement system **40** (such as REQI program **44A**). Local computer **20** will query OS/2 operating system **32** to determine the next application-name string **61** to create at start-up. The application-name strings **61** will be created in sequence with V123 being created first, V124 created second, etc. Each application will create only one application name-string **61** to support its user in the CICS environment **34**.

If the Fisher RIMS system has been selected as requisition/purchasing system **40**, and the TV/2 search program has been selected as search program **50**, CICS OS/2 applications **34** must share a workstation with a TV/2 search program **50**.

The data passed by interface **60** preferably comprise all or a subset of the following twelve fields: vendor name, vendor number, vendor part (catalog) number, product description, bid price, list price, keyword, page number, quantity, unit, catalog text, and catalog images. Because of the amount of data for catalog images present in database **36** and viewed on monitor **22**, these data are usually not passed via interface **60**. Any of the above-listed fields may be filled by requisition/purchasing system **40** prior to requesting a search of catalog database **36** by search program **50**. However, requisition/purchasing system **40** is not required to pass any data to search program **50**. If a field is not passed, that field will be filled with spaces. The fields that are filled with data will assist search program **50** in executing its first search against a specific catalog contained in catalog database **36**.

A search priority exists when more than one field is provided by requisition/purchasing system **40**. The priority is as follows: (1) part (catalog) number; (2) keyword; and (3) page number. The search will start with priority (1) and proceed through priority (3) in sequence until a search produces products matching the search criteria. At that time, the search will return the matching product information to requisition/purchasing system **40** and stop at the highest priority resulting in a match.

The operation of electronic sourcing system **5** of the present invention will now be more particularly described in the context of FIGS. **1A**, **1C**, **2** and **3**. In FIGS. **2** and **3**, the rectangles represent data screens as well as programs associated with those data screens. The rounded rectangles represent programs not associated with data screens such that, while these programs are running, the prior data screen may remain visible without, necessarily, being operational for the input of data. The programs associated with the data screens enable the user of local computer **20** to display and modify the contents of various tables associated with particular data screens. The following description illustrates the use of the Fisher RIMS system as requisition/purchasing system **40**, and the TV/2 search program as search program **50**. However, it will be understood that the present invention is not limited to such system or program.

Preferably, a user will start the electronic sourcing system **5** from Fisher RIMS system **40**. Requisitioning on Fisher RIMS system **40** in context of the electronic sourcing system **5** of the present invention is illustrated in pertinent part in FIG. **3** (and is fully described in application Ser. No. 08/042,168, now U.S. Pat. No. 5,712,989). As data (e.g., Account Number, Requisition Number and Stock Numbers) associated with a single requisition are entered through the various data screens on local computer **20**, that computer creates a set of Requisition Tables (including a Requisition Item Table **46**, shown in FIG. 1C) for that particular requisition. The Requisition Tables are stored in Requisition databases **42A** (shown in FIG. **1A**), and can be accessed by local computer **20** using the Requisition Number to find the desired table.

The first step in creating a requisition in Fisher RIMS system **40** involves entry by the user of information in the Order Header program **44D** (shown in FIG. **1A**), which has an associated Order Header data screen **100** (FIG. **3**). A sample of an actual Order Header data screen **100** is set forth in Appendix I. The user enters an Account Number, which generally causes the correct name and address associated with that Account Number to be entered into the appropriate

fields of Order Header data screen **100**. The user must also enter a Requisition Number in the appropriate field of the Order Header screen **100**. Various additional information may also be entered.

At the bottom of Order Header data screen **100** are several fields that describe the function of various function keys. Function keys F6, F9, and F10 all cause the system to jump to a new RIMS program **44** or data screen in Fisher RIMS system **40**. For example, pressing the F9 key causes the system to jump to RIMS Customer Variable program **44E** (FIG. 1A) and its associated Customer Variable Header data screen **104** (FIG. 3). Customer Variable Header program **44E** with its associated Customer Variable Header data screen **104** allows the user to enter and edit information that the particular customer desires to be associated with the requisition due to requirements of the customer's internal accounting system or other systems. Pressing the F10 key will cause the system to enter the Inventory Sourcing program or programs **44B**.

Pressing the F6 function key from the Order Header data screen causes Fisher RIMS system **40** to jump to REQI program **44A** (FIG. 1A). The screen associated with REQI program **44A** is Requisition Management data screen **110** (FIG. 3) illustrated in Appendix II. Within REQI program **44A** and its associated Requisition Management data screen **110**, Requisition Item Table **46** (shown in FIG. 1C) is a graphical representation of a database table in which certain fields are completed on a list of items that are to be listed, sourced and ordered. Representative Requisition Management data screens **110** showing a Requisition on Requisition Item Table **46** are set forth in Appendices II, VIII and IX. It should be appreciated that data about each item is stored in Requisition Item Table **46**, some of which is displayed on the screens shown in Appendices II, VIII and IX. The data stored can additionally include customer variable data. That is, the fields on Requisition Item Table **46** can be expanded to include specific item details used by a particular customer, especially when reports from requisition databases are transferred to the customer's host computer (not shown). The field structure for these data is maintained in customer-specific databases **42C**.

The entire process of listing, sourcing and ordering products using Fisher RIMS system **40** can be completed without any reference to a search program **50**. As described herein, however, limited fields on specific items can be transmitted from Requisition Item Table **46** to search program **50**, and more completed fields of the same or different items can be received from the search program **50** into a Requisition Item Table **46**.

At the bottom of Requisition Management data screen **110** (FIG. 3), and Appendices II, VIII and IX) are several fields which describe the function of various function keys (F1, F2, etc.). The user uses REQI program **44A** and its associated Requisition Management data screen **110** to enter the catalog or part numbers and quantities of the various items being requisitioned.

The Account Number and Requisition Number are automatically passed to REQI program **44A** and its associated Requisition Management data screen **110**, and displayed at the top of the Requisition Management data screen **110** in the relevant fields. For example, in the exemplary Requisition Management data screen **110** shown in Appendix II, the number 218848 has been entered in the Account Number field, and the notation "TEST NEW ONE" has been entered in the Requisition Number field.

The user can next enter desired items and quantities for the requisition. Each desired item may be identified by entering its distributor catalog or part number, if known, in the field below the STOCK NBR label on the appropriate line in Requisition Item Table **46** shown on Requisition management data screen **110**. In the sample Requisition Management data screen **110** shown in Appendix II, the part number 13246818F has been entered in the STOCK NBR field of Line **001**. Once the user has entered such information at least partially describing a desired item on Requisition Management data screen **110**, he or she may wish to initiate a search of catalog database **36** to find all the part numbers contained in catalog database **36** that match the part number entered or other information on Requisition Management screen **110**. If so, the user enters the letter "S" (for "Select") on the line number of the item that he or she wishes to search in catalog database **36**. The letter "S" has been entered to the left of line **001** on the sample Requisition Management data screen **110** shown in Appendix II. Any number of items, or no items, listed on Requisition Management data screen **110** may be marked with "S."

A user may not always have information relating to the catalog or part number for the particular items that are to be requisitioned using Fisher RIMS system **40**. Or, the user may have relevant information about an item from a particular vendor but may wish to locate information about the same or a similar product available from other vendors. Or, the user may simply know the name of the item that he or she wishes to requisition. In any of these cases, the user alternatively or additionally could enter text at least partially describing the product to be requisitioned in the "DESC" field of Requisition Management data screen **110** (e.g., Appendix II). Then, the user would initiate the electronic sourcing system **5** of the present invention to search the vendor product catalogs contained in catalog database **36**. Alternatively, the user could initiate search program **50** of electronic sourcing system **5** without having first entered information in RIMS system **40** about the product to be requisitioned.

Once the user has built or partially built Requisition Item Table **46** by filling the line numbers (entries) on Requisition Management data screen **110** and selecting those lines to be searched, he or she is now ready to initiate electronic sourcing system **5**. Pressing the F11 function key, which is labelled "Catalog," from Requisition Management screen **110** accesses electronic sourcing system **5**.

Referring now to FIG. **2**, after the user presses the F11 key on Requisition Management data screen **110** of Fisher RIMS system **40**, Fisher RIMS system **40** will pass program control via XCTL **74** to ESRC program **70**. XCTL **74** is a protocol within CICS application **34** that directs the execution of a program, as would readily be understood by one of ordinary skill in the art. As control is passed from REQI program **44A** to ESRC program **70**, ESRC-Comm-AREA data structure **76** is passed. ESRC-Comm-AREA is a layout of storage area in local computer **20** created by REQI program **44A** to pass data to ESRC program **70**, as would readily be understood by one of ordinary skill in the art. ESRC program **70** will then LINK **82** to ESCP program **80** with ESCP-Comm-AREA **84**. LINK **82** is a protocol within CICS application **32** that directs the execution of a program, as would readily be understood by one of ordinary skill in the art. Data at least partially describing one item desired to be requisitioned is passed to ESCP program **80** via LINK **82**. Thus, if there are five items to be passed to ESCP program **80**, there will be five LINKS **82** made. If no items are to be passed to ESCP program **80**, only one LINK **82** is made to ESCP program **80**. ESCP program **80** can return up to twenty items per LINK **82**; in other words, for each item desired to

be requisitioned up to twenty desired catalog items contained in catalog database **36** may be sent to REQI program **44A** and its associated Requisition Management data screen **110** of Fisher RIMS system **40**. If a user chooses to terminate the sourcing process, ESRC program **70** would return to REQI program **44A** and its associated Requisition Management data screen **110** without processing any of the records.

ESCP program **80** links with Shell **52** and TV/2 search program **50** via DDE LINK **90**. Shell **52** and TV/2 search program **50** search in catalog database **36** for the item or items desired to be requisitioned that has or have been passed from ESRC program **70** to ESCP program **80**. Catalog database **36** contains the following fields: vendor name, vendor number, vendor part (catalog) number, product description, list price, page number, quantity, unit, catalog text, and catalog images. Shell **52** and TV/2 search program **50** may, if desired, search the keyword field or any other field shown in Appendix VII. However, not all fields may appear on the monitor **22** of local computer **20**, although they are stored in memory.

After the user has pressed the F11 key from Requisition Management data screen **110** and control has been passed from REQI program **44A** to Shell **52** and TV/2 search program **50**, monitor **22** of local computer **20** will show a footer bar representative of Shell **52** at all times that the user is in the TV/2 search program **50**. The footer bar, which also includes appropriate icons, is used to make choices within Shell **52**. A sample of the footer bar (without the icons) representing Shell **52** is shown at the base of Appendices III–VII. In the screens of Appendices III–VI, this footer bar is active to select functions. In the screen of Appendix VII, this footer bar is in the background and another footer bar is used to select functions.

If the user has marked an item on Requisition Management data screen **110** with the designation "S," the entered data at least partially describing that item will be sent to Shell **52** and TV/2 search program **50A** in the manner described above. TV/2 search program **50** will search catalog database **36** for all items that match the search field sent over from REQI program **44A** and Requisition Management data screen **110**. When a search is performed in Shell **52** and search program **50**, a Hit List **47** is produced, as indicated in FIG. **1C**. The user would see on monitor **22** of local computer **20** a Hit List **47** screen representing limited data about all matching catalog items that were located in catalog database **36** as a result of the search. A sample Hit List **47** produced from a search initiated when the entry "OVENS" is received as the description or keyword by search program **50** from Requisition Item Table **46** is shown in Appendix III. Similar Hit Lists **47** are produced when various searches are performed from the Search Input screen shown in Appendix VII. When a Hit List **47** is depicted on monitor **22**, the underlying catalog text and pictures (in either partial or complete form) are typically collected in a memory location for rapid viewing, printing or other use.

When multiple catalogs are present in catalog database **36**, search program **50** contains a function associated with the catalog symbol of the footer bar and screen window (not shown) for selecting catalogs to be searched. For example, the following choices might be available:

1. Fisher General Catalog 93–94;
2. Fairmont Supplies Catalog;
3. NIST Standards Catalog; and
4. Promega Biological Research Products Catalog.

Fairmont and NIST catalogs list products not in the Fisher General Catalog, but many of the products listed in the Promega catalog are also listed in the Fisher General Catalog (identified by corresponding Fisher catalog numbers). If searching for a molecular biology product, the user would select the Fisher and Promega catalogs. TV/2 search program **50** would then concatenate those two catalogs to perform a keyword, catalog number or other subject search and generate a Hit List of pages (panels) from both catalogs where the searched-for items were found. Similarly, the user might select the Fisher and NIST catalogs when searching for quality control standards or might select the Fisher and Fairmont catalogs when searching for supplies.

If the search is initiated from requisition/purchasing program **40**, for example from the Requisition Management data screen **110** of the Fisher RIMS system, then the catalogs searched can be determined by the information provided. If, for example, Promega is indicated as the desired requisition item vendor, interface **60** would direct TV/2 search program **50** to search the Fisher and Fairmont catalogs. If no catalog delimiting information is entered for the item desired to be requisitioned, interface **60** would be set up to search only the Fisher catalog or, alternatively, to search all catalogs in catalog database **36**.

Once Hit List **47** has been created by TV/2 search program **50**, the user can view it and select particular ones of the located catalog items for Order List **48** that is being created in Shell **52**, as shown in FIG. **1C**. For example, a search for "Eco RI," a restriction enzyme, may have uncovered five entries in the Promega catalog (identified by Promega catalog numbers R6011, R6012, R6013, R6015 and R401) and five entries in the Fisher catalog (identified by Fisher catalog numbers PRR6011, PRR6012, PRR6013, PRR6015 and PRR4014). If the user selected PRR6012 from the Fisher catalog, Fisher catalog number PRR6012 would be added as an entry to the Items Selected screen, with VN00000001 (identifying the vendor as distributor Fisher) accompanying it in the Order List **48**. If the user instead selected the item identified by catalog number R6012 from the Promega catalog, then Promega catalog number R6012 would be added as an entry to the Items Selected screen, with VN00005860 (identifying the vendor as Promega) accompanying it in the Order List. In either case, the information transmitted to REQI program **44A** of Fisher RIMS system **40** would also include description, list price and other information taken from the catalog database from which the selection was made. When the resultant requisition is sourced, however (as described below), Distributor's mainframe host computer **10** would recognize the entry for the item from vendor Promega's catalog (R6012, 00005860) as corresponding to that same item available from Fisher's catalog (PRR6012, 00000001). The system thus would transmit back the Customer's contract price and availability for corresponding item PRR6012 as a type 03 (regular Distributor) product available from one of distributor's inventory locations. A purchase order then would be generated for this corresponding Distributor item as further described below.

By contrast, an item selected from the Fairmont catalog would be transferred to Fisher RIMS system **40** with the vendor number for Fairmont, and would be recognized during inventory sourcing as either a type 07 product (that Distributor orders from Fairmont) or as a type 05 item (that Customer orders from Fairmont as an Administrative Purchase). In either of these two cases, a purchase order would be generated for an item, corresponding to a desired catalog item, that is identified by the same Fairmont catalog number that was requisitioned.

After the desired item has been selected from the Hit List **47** by double clicking on that item TV/2 search program **50**

can be used to bring up for viewing on monitor **22**, or printing on printer **26**, images and text from the catalog page on which the item selected is located. For example, as shown in Appendix III, page 1106 of the Fisher catalog has been selected. If the user double clicks on highlighted page 1106, the text shown in Appendix IV (and related images, not shown) would appear on monitor **22**. On the sample screen shown in Appendix IV, the item that appears on page 1106 of the Fisher catalog relates to Fisher Isotemp 800 Series Programmable Ovens. Conventional scroll bars appearing on the screen (not shown in Appendix IV) enable the user to scroll through additional catalog information (text and/or images) not yet displayed on the screen. An example of such additional textual information is depicted on the screen shown in Appendix V.

On the screen of Appendix V, the vendor distributor's catalog number ("Cat. No.") 13-246-818F is highlighted. The catalog number of an item normally appears in blue in a screen such as Appendix V. This blue lettering is used for catalog numbers, trademarks, footnotes and other entries for which database **36** contains additional information or cross-references (called hyperlinks). When a search is conducted and the catalog segments of the resultant hit list are reviewed, the test corresponding to the search parameter is highlighted in red. Thus, in Appendix V, catalog number 13-246-818F (identified in the search) appears in red, while catalog number 13-246-838F and the trademark Isotemp each appear in blue. A word, vendor part number or catalog number located by the search will appear red, even if that word or number did not have an associated hyperlink (and thus is not normally blue).

When in search program **50**, particular items selected can be added to an Order List **48** pending in Shell **52** and search program **50**. When the Ordering portion of catalog text is viewed (as in Appendix V), particular items can be selected so as to be added to the Order List **48** by double clicking on the highlighted catalog number (even if a different field was also highlighted as a result of a search of catalog database **36**). The item is then added to an Order List **48** that is created in Shell **52** via a hypertext link. The items that are sent to the Order List **48** are collected and shown on the Items Selected screen of Shell **52**. An example of an Items Selected screen of Shell **52** is shown in Appendix VI. The Items Selected screen depicts certain fields of Order List **48** that can be viewed and edited within search program **50**. For example, Shell **52** permits the user via a pop-up window (not shown) to select units, e.g. pack or case, and quantity to be ordered, e.g. two packs. Alternatively, the data in these fields can default to one of the smallest unit and the units can be changed when the order is reviewed in REQI program **44A**. Additional fields on the same items are also present in memory at this stage. Upon clicking on "Order" when the Items Selected screen (Appendix VI) is viewed, many or all of these fields on the items in the Order List are transmitted back to REQI program **44A** (via the programs of interface **60** shown in FIG. 2) to be added to the pending Requisition Item Table **46**. The sample Items Selected screen shown in Appendix VI includes the Isotemp Oven with catalog number 1324818F that was located as a result of the search for all items in catalog database **36** that match the part number 13246818F that was entered in the STOCK NBR field of REQI program **44A** and its associated Requisition Management data screen **110** of Fisher RIMS system **40**.

The following fields are transferred to Order List **48** created in TV/2 search program **50**: Vendor name, vendor number, vendor part (catalog) number, product description, list price, page number, quantity, unit and catalog text. However, not all of these fields are viewed on the Items Selected screen.

If more than one item on Requisition Management data screen **110** had been marked with an "S," the process described above is repeated.

If the user desires to do additional searching in catalog database **36** that is not connected to catalog or other items that have been listed on Requisition Management data screen **110** of Fisher RIMS system **40**, he or she can click the box on footer bar of Shell **52** that is labelled "Search." Then, a Search screen comes up on monitor **22** of local computer **20**. An exemplary Search screen is shown in Appendix VII. In this screen, the usual footer bar is visible in the background, but is not active.

Using the Search screen, a user can search catalog database **36** by page, text description, part number (where the user has the further option to search by Fisher part number, for example if Fisher is to be the desired vendor), Vendor part number, vendor name (for vendors other than Fisher), or bulletin. Stock numbers specific to the customer can also be present in catalog database **36** and searched using the screen of Appendix VII. "Bulletin" refers to an additional vendor publication with detailed product information that may not be included in a vendor catalog. Searching for information contained in bulletins may be done by bulletin number, but only if bulletins have been made a part of catalog database **36**. For purposes of this disclosure, bulletins when included in a catalog database are considered a type of catalog.

After the user has entered the field to be searched on the Search Screen, the user clicks on the "SEARCH" box near the bottom of the Search Screen. A Hit List **47** indicating all items from catalog database **36** that match the search field that was entered on the Search Screen then is generated. Then, in a manner similar to that described previously, the user can scroll through the Hit List **47** and double click on the catalog page or panel desired. The user may then also view the detailed information located on the catalog page that was selected from the Hit List **47**. During the search, the user may also add additional items to the Order List **48** being built in Shell **52** if desired, whether those additional items had been selected from the Hit List **47** or not.

The Order List that the user has built in Shell **52** is maintained on the Items Selected screen, shown in Appendix VI. From the Items Selected screen, the user can cancel the order by clicking on the "Cancel" box at the bottom of the screen, delete an item from the Order List **48** by moving the pointer bar to the item to be deleted and then clicking on the "Delete" box at the bottom of the screen, or delete all items by clicking on the "Delete All" box. The user can also view catalog text and images for a particular item by clicking on the "Description" box.

Once the user has completely built the Order List **48** within Shell **52** and TV/2 search program **50**, he or she can transmit it to Fisher RIMS system **40**. This is accomplished by clicking on the "Order" box at the bottom of the Items Selected screen to communicate the completed Order List **48** to Fisher RIMS system **40**.

The user may have selected no items, one item or several items from the catalogs contained in catalog database **36** by using TV/2 search program **50**. If no items have been selected, the original items that were entered on Requisition Item Table **46** of Requisition Management data screen **110** will remain on that screen and will continue to be processed by Fisher RIMS system **40**. If one or several desired catalog items were selected in TV/2 search program **50**, the first item selected will replace the original item on Requisition Item Table **46** of Requisition Management data screen **110**. Addi-

tional items that were selected from the search that was performed in TV/2 search program **50** will be added to Requisition Item Table **46** of Requisition Management data screen **110**.

Interface programs ESCP **80** and ESRC **70** (FIG. 2) are used to send data to REQI program **44**A (FIG. 1A) and its associated Requisition Management data screen **110** (FIG. 2) about the items that were selected from the search performed by TV/2 search program **50**. To the user, it appears that all the items selected from the search are sent over to Fisher RIMS system **40** at the same time. However, ESCP program **80** receives multiple items from TV/2 search program **50**, and then sends one item at a time to ESRC program **70**. ESRC program **70** then waits until all items have been passed to it before sending data about the items to REQI program **44**A and its associated Requisition Management screen **110** of Fisher RIMS system **40**. The information transmitted to Requisition Management screen **110** from the Order List built in TV/2 search program **50** and sent through ESCP program **80** and ESRC program **70** includes vendor name, vendor number, vendor part (catalog) number, product description, list price, page number, quantity, unit and catalog text. However, not all of the above-listed fields may be displayed on screen at all times. ESRC program **70** passes control back to Fisher RIMS system **40** via XCTL **78**. The requisition number, customer identification and release number (or other data identifying the requisition) will be passed in MENU-Comm-AREA **56** to confirm that the returned data are associated with the proper requisition. MENU-Comm-AREA **56** is a layout of storage area within local computer **20**, as one of ordinary skill in the art would readily understand.

As previously indicated, multiple LINKS **82** may have been created between program ESRC **70** and program ESCP **80** if multiple lines were selected (with the "S" symbol) in Requisition Management data screen **110**. After completing the first search, and any additional searches initiated with the footer bar, an order list is created and returned to Requisition Item Data Table **46** associated with Requisition Management data screen **110**. At this point, the next item is sent from a LINK **82** through program ESCP **80** and DDE LINK **90** to the TV/2 program **50**, and a hit list resulting from the corresponding search is displayed on monitor **22**. The process of searching, displaying, selecting and ordering is repeated until all of items stored by LINKS **82** have been sent to TV/2 program **50** and searched. At the end of each of these searches, an order list may be created and returned to Requisition Item Data Table **46** or cancelled. Once the last item is completed, ESRC program **70** passes control via XCTL **78**, and a Requisition Management screen **110** is displayed, reflecting all of the additions and changes that have been made to the Requisition Item Data Table **46** associated with that requisition.

A limit is normally placed on the number of items of an order that may be returned to the Requisition Item Data Table **46**. For example, if the maximum size in Requisition Item Data Table **46** is set at 200 lines, one could create a limit on the size of each order list at 20, 50, 100 or even 200. A corresponding limit can be placed on the number of LINKS **82** that can be established concurrently from the same requisition. Setting a limit of five LINKS **82** and forty items per order list would be one way of avoiding situations in which a Requisition Item Data Table **46** reaches its limit (e.g., 200 lines) before all of the searches (five) have been completed and order lists (five of forty items each) have been returned.

At this point in the use of Fisher RIMS system **40**, as many entries (lines) of Requisition Management data screen **110** have been built up (some through use of electronic sourcing system **5**) as are necessary to complete the requisition. A sample of such a Requisition Management data screen **110**, in which four lines have been entered identifying desired items to be requisitioned (including catalog items located as a result of a catalogs search), is shown in Appendix VIII. The next step is that of inventory sourcing using RIMS inventory sourcing program or programs **44**B in Fisher RIMS system **40**, as shown in FIG. **3**. Inventory sourcing is the process of determining what inventory will be used to fill the requisition. Pricing is also performed in this step when it is called for. Inventory sourcing in Fisher RIMS system **40** is performed on both local computer **20** and host computer **10**.

Within Fisher RIMS system **40**, a Requisition Item Table **46**, as shown in Appendix VIII (similar to that shown in Appendix II, but including more items), can be inventory sourced by pressing the key F6 from REQI program **44**A represented by Requisition Management data screen **110** shown in Appendix VIII (and in Appendix II). Since inventory records on JIT items (type 01 and 06) are maintained in inventory database **42**B, lines **002** and **004** in Appendix VIII show the availability of these items in inventory (49 items available for line **002**, and 0 items available for line **004**). After the F6 key has been pressed, host computer **10** searches its host pricing and inventory databases for availability of the various items listed on Requisition Management data screen **110** in different inventory locations (e.g., different warehouses) as described in further detail, below.

After such inventory sourcing, and assuming that no errors occurred during sourcing (as indicated by decision step **116** in FIG. **3**), the contract price, source (inventory) location and available quantity or other fields are communicated back to computer **20** by host computer **10**, and entered and displayed in the Requisition Management Screen. This can best be seen by comparing lines **001** and **003** of Appendix VIII to Appendix IX, especially as to "QTY AVAIL" (quantity available), "LOC" (inventory location) and price. As Appendix IX indicates, an inventory-sourced Requisition Item Table **46** typically contains the same items, but with more completed fields (including price, product type and inventory location). Moreover, as discussed above, an entry in an inventory-sourced Requisition Management screen may indicate for a requisitioned item a vendor and vendor catalog number that has been changed, from what was obtained from a catalog search, to a corresponding vendor and vendor catalog number for that item from another source (e.g., Fisher—which has its own catalog number for that manufacturer's item that Fisher distributes).

For example, as shown in Appendix IX, product type "01" for the item on line **002** indicates that the requested requisition item is available as Distributor-owned inventory in the JIT inventory that the vendor/distributor maintains near local computer **20**, either for the particular Customer or for a group of customers. Product type "06" for the item on line **004** indicates that this item is available for the requisitioner employed by the Customer from inventory owned by Customer's purchasing department but managed by local computer **20**. Product type "03" for the items on lines **001** and **003** indicates that these are regular Distributor items that the communication between Distributor's host computer **10** and local computer **20** determined were available in sufficient quantity at one or another of Distributor's general warehouses designated "DEL" and "EDC" in the location ("LOC") field. Product type "05" (not shown in Appendix IX) indicates that a requisitioned item is to be purchased by Customer directly from an outside supplier, using an Admin-

istrative Purchase Order that local computer **20** creates and prints (or transmits) for Customer.

The inventory sourcing process described above also determines the net prices shown in Appendix IX for each item. Type 01 and type 03 items are priced by Distributor's host computer **10** searching host databases **11**, which contain various formulae and tables of Distributor's pricing agreement with the Customer. Host computer **10** also prices any type 04 or type 07 item, if present. These prices were transmitted to local computer **20** along with the location and availability information for the type 01 items. Prices for type 05 and 06 items are maintained in the local computer's **20** own databases **42B** and **42C**.

From Requisition Maintenance data screen **120**, the CSR can accept all lines of the requisition—if all lines show the status "S" for sourced in the "STAT" field of Requisition Maintenance data screen **120**—by pressing the F6 function key. If item errors are found at step **116** in the data transmitted back to local computer **20** from host computer **10** during the sourcing process, then those particular items for which error was found will be returned and displayed by local computer **20** in Requisition Management data screen **110**.

Once a requisition has been inventory sourced and accepted by the CSR, it can be converted to one or more purchase orders, as represented by step **114** in FIG. **3**. For example, the requisition represented by the Requisition Item Table **46** of Appendix IX, if accepted without further revision by pressing function key F6 ("ACCEPT"), would result in the generation of the following three purchase orders:

A. Line **002** would be ordered from on-site distributor-owned inventory;

B. Line **004** would be ordered from on-site customer-owned inventory (a transfer internal to the customer); and

C. Lines **001** and **003** would be ordered, respectively, from Distributor's "DEL and "EDC" warehouses.

Of these three purchase orders, Orders A (type "01") and C (type "03") are shared between host computer **10** and local computer **20** (as shown in FIG. **3**). Upon execution of Order A, the inventory records on both computers for Distributor-owned JIT inventory are adjusted synchronously. A purchase order is generated by host computer **10** immediately thereafter. Order B (type "06") is executed and stored only on local computer **20**. Upon execution of Order B, the inventory record on local computer **20** is adjusted (the host computer contains no records on Customer-owned JIT inventory or on items ordered by Administrative Purchases). For Administrative Purchases (type 05 items), a purchase order is printed, and mailed or faxed, locally by computer **20** as indicated at step **118** in FIG. **3**, or via host computer **10** via EDI (if EDI was selected in the Header of Appendix I and an EDI transfer arrangement existed with vendor).

It is an important feature of the present invention that a requisition may be filled by searching and selecting from a catalog database of items, inventory sourced, and the resulting requisition then divided into one or more purchase orders. This contrasts with known prior art CD-ROM catalog systems in which only a single purchase order to a single supplier is built without reference to inventory records, and in which the information used to create the purchase order is limited to that contained in the product catalog of a single vendor.

Electronic sourcing system **5** also contains the capability to log messages returned from inventory sourcing program or programs **44B** of Fisher RIMS system **40**. Messages will be logged for any of the following reasons: (1) part number changes for line sent to ESCP program **80**; (2) list price from inventory sourcing program **44B** differs from list price returned from ESCP program **80**; (3) vendor name from inventory sourcing program **44B** differs from vendor name returned from ESCP program **80**; (4) on a "master or blanket" order, in which local computer **20** tracks the amount of purchases against a blanket or cumulative sum available and/or in which there is limited access to products or limited access to certain users, the part has already been entered on another line; and (5) the maximum number of line items has been reached.

Referring again to FIG. **2**, a user is able to view the messages returned by pressing the ALT F11 function keys in REQI program **44A** and its associated Requisition Management screen **110** in Fisher RIMS system **40**. After the ALT F11 keys have been pressed, REQI program **44A** will link to ESMV program **112** via XCTL link **111** for displaying the message log created. ESMV program **112** is a function of Fisher RIMS system **40**. ESMV program **112** allows the user to page through the messages created and then to return to Requisition Management screen **110**. A sample ESMV message screen associated with ESMV program **112** is shown in Appendix X.

The first two messages of the message screen of Appendix X indicate that a part number for line **001**, identified as part number 53610, was successfully added in substitution for a prior part originally entered as part number S100-06 (from the Fisher Scientific catalog). These messages were generated because the originally entered part (S100-06) did not exist in the Fisher catalog, but its corresponding part number S100-06 (that was located by another search in another catalog) did exist in that other catalog. The next message indicates that the vendor for part number 53610 was changed in line **001** from "VN00000001"—meaning that the originally requested vendor (Fisher) was changed. The next two messages indicate that two other part numbers (53620 and 53650) were successfully added as lines **002** and **003**.

In the previous description, an exemplary embodiment has been described in which a Distributor CSR operates Fisher RIMS requisition/purchasing system **40** and IBM TV/2 search program **50** as part of a Just-In-Time activity for a particular customer, Customer. Electronic sourcing system **5** of the present invention may also be used, however, in other requisition and purchasing environments.

In some embodiments, a Customer end user or a Customer purchasing employee operating REQI program **44A** of Fisher RIMS system **40** may also operate TV/2 search program **50**. Operating either from a terminal connected to local computer **20**, or from a separate local computer networked with the CSR's local computer **20**, such a Customer end user can select requisitioned items for inclusion in Requisition Item Table **46** by keystrokes viewing that screen and by searches in TV/2 search program **50** which are transmitted to the Requisition Item Table **46** via interface **60**, as described above. Depending upon his or her authorization level and access code to Fisher RIMS system **40**, the Customer purchasing employee may be able to source the final requisition and/or accept the sourced requisition, as shown in Appendix IX. If, however, the sourced requisition was split into more purchase orders than the Customer purchasing employee might prefer, the intervention of the Distributor CSR could be invoked to revise and re-source the requisition (causing, for example, certain items originally sourced as type 01 products to be sourced for this order as corresponding type 03 products from a common Distributor warehouse with other type 03 products on the requisition). The Customer end user may have authority only

to build the Requisition Item Table, but then calls the Distributor CSR or Customer purchasing employee to source and accept the requisition.

As shown in FIG. 1B, the present invention also has application to Distributor's regional customer service locations where a large number of CSRs may be placing orders directly on Distributor's host computer **210** for thousands of different customers who call in. In that environment, search program **250**, which preferably comprises TV/2 search program **250**, and catalog databases **236** are stored on file server **200**. In this environment, file server **200** is a large personal computer, a work station or a mini-computer such as an IBM AS/400. Alternatively, the server **200** and a minicomputer (such as an IBM AS/400) can be independently connected to each local computer **200**. Each CSR has a local personal computer **220** having a monitor **222**, a keyboard **224** and a printer **226**. Local computer **220** is provided with programs including requisition/purchasing program **240**, Shell program **252** and a graphic user interface **254** (preferably EASEL Workbench program **254** for OS/2) for listing items. One or more of these may be copied from server **220** when needed. Work-in-progress requisitions **260** are established for each customer and are attached to graphic user interface **254**. Server **200** maintains complete requisitions **242**, in a manner similar to the manner in which local computer **20** maintains requisition databases **42** in the embodiment shown in FIG. 1A.

Normally, in such an environment, the CSR creates Order lists for customers by entering Distributor catalog numbers into graphic user interface **254** and connecting to the Distributor mainframe **210** for price and availability. For this purpose, each local computer is connected to host computer **210** via a phone/dataline and either a gateway or a minicomputer acting as a local host. When a customer asks for products by manufacturer part number or a competitor's catalog number, the CSR has access to cross-reference files, as earlier described, either maintained on the local host or maintained on the Distributor host computer **210**.

Appropriate Distributor catalogs and manufacturer catalogs then are consulted, using TV-2 search program **250** and proper selection of Distributor catalogs and of catalogs and bulletins from manufacturers whose products Distributor regularly sells. Catalogs and bulletins are contained in catalog database **236**. The resultant lists of products are then transferred by Shell program **252** to a work-in-progress requisition **260**, and then entered from graphical user interface **254** directly onto Distributor's mainframe computer **210** as orders from the applicable customer to Distributor. The CSR, knowing which items are available from which Distributor warehouse and direct-shipping supplier, then may divide the customer's requested items into multiple orders, so as to assure that each order is completely filled by a single shipment. In this regional environment, file server **200** or the minicomputer acting as local host can maintain files of completed requisitions **242** which can be subsequently used for generating reports for customers in the region. Reports can be generated either from such local data or from data periodically downloaded to the local host from Distributor's host computer **210**.

Another environment where the present invention can be used is in Distributor's purchasing department. The item lists created in that environment can include lists of items Distributor does not regularly stock or purchase, but for which particular customers indicate a requirement to buy. The file server **200** in that environment contains TV-2 search program **250**, EASEL graphical user interface **254** and multiple catalog databases **236** containing catalogs similar to the Fairmont and NIST catalogs described above for the embodiment of FIG. 1A. The Distributor purchasing employee can receive by phone or via Distributor's host computer **210** requests for items not shown on Distributor's host databases either as regular products (type 03) or third party items purchased for particular customers on a regular basis (type 07 items). Transmitting certain such requirements to the applicable Distributor purchasing employee can be a function of the inventory sourcing routines of host computer, or may be directed by the Distributor CSR interfacing with the customer.

The Distributor purchasing employee can search appropriate catalogs using TV-2 search program **250**, and can transfer the "Items Selected" to a product list in EASEL interface **254**. The resultant list might display, for example, supplier part number, supplier, list price, product and catalog page, with access to other fields such as complete description (up to 500 characters). The Distributor purchasing employee can then either forward the information to the CSR, customer end user or customer purchasing employee who requested the item (to confirm that the requirement is being met) or contact the supplier to confirm pricing and availability. Once responses from either or both have been obtained, the Distributor purchasing employee can use the item list in EASEL interface **254** to create one or more of the following purchase orders:

1. an order from the customer to the supplier (an Administrative Purchase);
2. an order from the customer to Distributor (for a type 07 product); and
3. an order from the Distributor to the supplier (usually providing for direct shipment from the supplier to the customer or to a JIT site maintained by Distributor for the customer).

From the foregoing description, it should be apparent that the network arrangements of FIG. 1B can be used to apply the present invention in a variety of contexts. The context will dictate which catalog databases **236** are provided on file server **200**: in the regional CSR environment, Distributor's catalogs can be present with a variety of catalogs and bulletins from manufacturers that Distributor regularly represents and a limited selection of outside suppliers; and in the Distributor purchasing environment, the number of outside supplier catalogs will be increased. The number of client (local) computers **220** and the number and size of catalog databases **236** will help dictate what size file server **200** is required. The operating environment (regional CSR site, on-site CSR, on-site CSR networked with Customer end users and with purchaser personnel or Distributor purchasing site) will also affect the catalog databases **236** included, file server **200** size and requisition/purchasing program **240** used. In some situations (e.g., purchasing) each client computer has an independent copy of requisition/purchasing program **240**; in others (e.g., on-site CSR) a single copy of the requisition/purchasing program **240** is maintained with associated local databases on the server **200**. Where the requisition/purchasing program **240** and local databases are maintained on file server **200**, the local database is updated after each use for the benefit of subsequent users. For example, in an environment using Fisher RIMS for requisition/purchasing program **240**, if a NIST standard is selected using TV-2 search program **250** and ordered using Fisher RIMS **240** (as either a type 07 purchase from Distributer or a type 05 administrative purchase from NIST), that item is available in the applicable database for subsequent requisitions. For example, a NIST standard ordered as a type 05 item will be stored in the local database

on file server **200**, with NIST as the vendor for subsequent administrative purchases by Customer. A NIST standard ordered from Distributor as a type 07 item will be stored in Distributor's host databases as a type 07 available to Distributor from NIST. The local databases on file server **200** will also contain records of all items requisitioned and ordered, useful to transfer files to a Customer's computer (e.g., of purchase orders placed by that Customer in a day) or to generate reports for a Customer (e.g., or requisitions placed by each Customer department and/or budget number in a week).

Thus it is seen that an electronic sourcing system including means for linking a requisition/purchasing system and a means for searching large volumes of information has been described. Persons skilled in the art will appreciate that the present invention can be practiced by other than the described embodiments, which are presented for the purposes of illustration and not of limitation, and the present invention is limited only by the claims which follow.

APPENDIX I

FISHER SCIENTIFIC RIMS
REQUISITION HEADER

```
     DATE: 08/05/94
     TIME: 07:04:57
 ACCT-NBR:              NAME:
                     ADDRESS:
  COMPANY: :
           :
  REQ NBR: :
  RELEASE:          ORDER TYPE: R ORDER
                      HOLD/REL: I              RUSH CODE: 9
   CALLER:         FREIGHT OVERRIDE: N         TAX OVERRIDE:
                  EDI PO TO HOST: N POA 855
     ATTN:              PRT ACK: Y             NBR OF COPIES: 1
                    ACK DELV CODE: P PRINT & DELIVER
  BILL TO:          REQ DELV CODE: W WALK IN
                   SERVICE CHARGE: 0.00
  VENDOR:
                         CREATED: 08-04-1994          STATUS: R
 RESPONSE:     KEY(S):
 +F2: ADD  F3: EXIT  F4: UPDATE  F5: REFRESH  F6: ITEM  F9: VAR  F10: SRCE  F11: CHGPO  F12: DEL
13V123
```

APPENDIX II

*** REQUISITION MANAGEMENT SCREEN ***

```
ACCT NBR: 218848 002  REQ NBR: TEST NEW ONE
    COMP:   1         REL NBR:
  S LINE  STOCK NBR      QTY   UM  PT   STKRM XREF SPI   UNIT PRICE    EXT PRICE
     001  13246818F      0     CS  03                    0.00          0.00
    DESC:                          QTY AVAIL:    0   LOC:   FSHR WHSE: BLW
     002
    DESC:                          QTY AVAIL:        LOC:   WHSE:
     003
    DESC:                          QTY AVAIL:        LOC:   WHSE:
     004
    DESC:                          QTY AVAIL:        LOC:   WHSE:
     005
    DESC:                          QTY AVAIL:        LOC:   WHSE:
RESPONSE:     KEY(S):
ALL ITEMS DISPLAYED
   F3: EXIT  F6: SOURCE  F7: BKWD  F8: FWD  F9: NEW  F10: NONCAT  F11: CATALOG  F12: CNCL
```

APPENDIX III

```
ovens
General
(1106)Fisher Isotemp 800 Series Programmable Ovens
(1107)Isotemp 700 Series Deluxe Lab Ovens
(1108)Isotemp 600 Standard Lab Ovens
(1109)Fisher Isotemp 500 Series Economy Lab Ovens
(1110)Gravity Convection Ovens
(1111)Utility ovens
(1112)Mechanical Convection Ovens with Electronic Temperature
(1113)General-Purpose Ovens
(1114)Heavy Duty Deluxe Ovens
```

-continued

(1116)Large Capacity Model 2882A
(1117)Standard Capacity Model 281A
(1118)Fisher Models 280 and 285 Vacuum Ovens
(1119)NAPCO Vacuum ovens
Help Catalogs Search Order List Minimize Clear Prev Next Exit

APPENDIX IV

(FSC1106)Fisher Isotemp 800 Series Programmable Ovens

Fisher Isotempx 800 Series Programmable Ovens
Three linear heat-up and cool-down stages
Talking control panel
Keypad and lighted graphics
30° to 325° C. range
Rs-422 serial communications capability
The latest technology at your fingertips. Accurate, easy-to-use controls allow you to program up to 3 heat-up stages and 3 cool-down stages linearly to provide the most appropriate conditions for your samples. Using the large keyboard, you can choose the heat-up or cool-down rate, the temperature you want for each stage, and the length of time you want the oven to hold each temperature. And, for projects requiring repeatability, you can duplicate the settings at any time.
Help Catalogs Search Order List Minimize Clear Prev Next Exit

APPENDIX V

(FSC1106)Fisher Isotemp 809 Series Programmable Ovens

Model	818F	838F
Inside D x W x H	16 x 12 x 16 (41 x 30 x 41 cm)	18 x 18 x 20 (46 x 46 x 51 cm)
Shp. Wt.	156 lb. (71 kg)	195 lb. (88 kg)
Electrical Requirements	230 V 50/60 Hz 11.3 Amps	230 V 50/60 Hz 19 Amps
Cat. No.	13-246-818F	13-246-838F
Each	3495.00	3995.00

Extra Shelves for 800 Series Ovens
No-tip design. Move to any position in seconds. Full Depth Shelves: Chrome-Plated Steel
Help Catalogs Search Order List Minimize Clear Prev Next Exit

APPENDIX VI

ITEMS SELECTED

Part Number	Description	List Price
13246818F	ISOTEMP OVEN MDL818F 230 V	3495.00

Help Cancel Delete Delete All Order Description

APPENDIX VII

SEARCH
Page:
Search For:
Part Number: OFisher OVendor OCustomer
Vendor Name:
Bulletin:
HELP SEARCH CANCEL CLEAR USER DATA EXTENDED
Help Catalogs Search Order List Minimize Clear Prev Next Exit

APPENDIX VIII

RICREQI1 FISHER SCIENTIFIC RIMS DATE: 07-29-94
REQUISITION MANAGEMENT SCREEN TIME: 14:54:22

ACCT NBR: 363690 006 REQ NBR: PO NBR 001
COMP: 1 REL NBR:

0 LINE	STOCK NBR	QTY	UM	PT	STKRM XREF SPI	UNIT PRICE	EXT PRICE
001	A191	1	EA	03		0.00	0.00
DESC:				QTY AVAIL:	0 LOC:	FSHR WHSE: EDC	
002	02540K	1	PK	01		0.00	0.00
DESC:				QTY AVAIL:	49 LOC:	WHSE: JIT	
003	13246818F	1	EA	03		0.00	0.00
DESC:				QTY AVAIL:	0 LOC:	FSHR	WHSE: EDC
004	A181-06	1	EA	06		100.00	100.00
DESC:	ACETONE			QTY AVAIL:	0 LOC:	WHSE: JIT	
JIT BACKORDER WILL OCCUR							
005							
DESC:				QTY AVAIL:	0 LOC:	WHSE:	

RESPONSE: KEYS(S):
I ITEM(S) PROCESSED

-continued

```
          +F3: EXIT   F6: SOURCE   F7: BKWD:   F8: FWD   F9: NEW ITM   F10: NONCAT
                                   F11: CATALOG   F12: CNCL
1B V123
```

APPENDIX IX

```
RICPOMP1                    FISHER SCIENTIFIC RIMS                    DATE:  08-03-94
                        REQUISITION MANAGEMENT SCREEN                 TIME:  07:44:13

    COMP ID: 001          REQ-NBR: PO NBR 001
  ACCT NBR: 363690 006    REL-NBR:
 ORDER NBR:                          PICKLIST REVIEWED:
SERVICE:        0.00 ORDER:      0.00      FREIGHT:
CARRIER:
O LINE   PART          QTY   UOM PRD   UNIT PRICE    SERVICE   EXT PRICE   LOC  STAT
001      A181          1     EA  03    35.30         0.00      35.30       DEL  S
           ACETONE CERTIFIED ACS      1L    QTY AVAIL:  1    QTY REC:  0
002      02540K        1     PK  01    32.70         0.00      32.70       JIT  S
           BEAKER GRIFFIN 250 ML      12/9  QTY AVAIL:  49   QTY REC:  0
003      13246818F     1     EA  03    3495.00       0.00      3495.00     EDC  S
           PROGRAMMABLE OVEN          QTY AVAIL:  0    QTY REC:  0
004      A181-06       1     EA  06    100.00        0.00      100.00      JIT  S
           ACETONE                    QTY AVAIL:  0    QTY REC:  0
 RESPONSE:    KEY(S):
  +F3: EXIT   F6: ACCEPT   F7: BKWD   F8: FWD   F9: PRINT ACK   F11: M/B ERRORS   F12 DELETE
1B V123
```

APPENDIX X

```
                    *** REQUISITION MANAGEMENT SCREEN ***

 ACCT NBR: 218848 002      REQ NBR: TEST NEW ONE
    COMP: 001              REL NBR:
                    ELECTRONIC SOURCING MESSAGES
          LINE NUMBER              001          PART NUMBER 53610
PART ADDED SUCCESSFULLY
          LINE NUMBER              001          PART NUMBER 53610
REPLACEMENT WAS MADE FOR PRIOR PART: S100-06
          LINE NUMBER              001          PART NUMBER 53610
VENDOR CHANGED FROM: VN00000001
          LINE NUMBER              002          PART NUMBER 53620
PART ADDED SUCCESSFULLY
          LINE NUMBER              003          PART NUMBER 53650
PART ADDED SUCCESSFULLY
                    F6: RETURN   F7: BACKWARD   F8: FORWARD
```

We claim:

1. An electronic sourcing system comprising:

a collection of catalogs of items stored in an electronic format;

a first set of pre-determined criteria associated with said collection of catalogs;

a second set of pre-determined criteria associated with items from each of said catalogs;

a catalog selection protocol, said catalog selection protocol relying on said first set of pre-determined criteria to select less than said entire collection of catalogs, and including matching a vendor identification code with a subset of said collection of catalogs, wherein said subset of catalogs includes both a vendor catalog from a predetermined vendor and a second catalog from a predetermined third party that is one of a manufacturer and a competing vendor, said predetermined third party selling items corresponding to items in said vendor catalog; and

a search program, said search program relying on said second set of criteria to select specific items from said catalogs determined from said catalog selection protocol.

2. An electronic sourcing system as recited in claim 1, wherein catalogs comprising said collection of catalogs are stored in separate databases.

3. An electronic sourcing system as recited in claim 1, wherein said catalogs comprising said collection of catalogs are stored in a single database.

4. An electronic sourcing system as recited in claim 1, wherein said predetermined third party makes items in said vendor catalog.

5. An electronic sourcing system as recited in claim 1, further including a cross reference table linking a vendor item catalog number from said vendor catalog with an item catalog number from said predetermined third party.

6. An electronic sourcing system as recited in claim 1, wherein said second set of predetermined criteria includes at least one of a catalog number and item textual information.

7. An electronic sourcing system as recited in claim 1, wherein said catalog selection protocol includes providing an electronic listing of available catalogs from said collection of catalogs.

8. An electronic sourcing system as recited in claim 7, wherein said electronic listing of available catalogs is less than said collection of catalogs.

9. An electronic sourcing system comprising:

a collection of catalogs of items stored in an electronic format;

a first identification code associated with a first item in a first catalog;

a second identification code associated with a second item in a second catalog, said first item and said second item

being generally equivalent, and wherein a selection of one identification code from one of said first and second catalogs provides the other identification code from the other of said catalogs.

10. An electronic sourcing system as recited in claim **9**, wherein said first identification code is identical to said second identification code.

11. An electronic sourcing system as recited in claim **9**, wherein at least of one of said first and second catalogs includes said first and second identification codes.

12. An electronic sourcing system as recited in claim **9**, wherein said selection includes a comparison of said one of said first and second identification codes with a cross-reference table listing both of said identification codes as being generally equivalent.

13. An electronic sourcing system as recited in claim **9**, wherein a user selects one of said first and second identification codes, lacks access to said catalog corresponding to said selected identification code, but is given access to the other said catalog corresponding to said non-selected identification code.

14. An electronic sourcing system as recited in claim **9**, wherein a user selects one of said first and second identification codes, and has access to both said first and second catalogs.

15. An electronic sourcing system as recited in claim **9**, wherein said first and second identification codes correspond to a part number.

16. An electronic sourcing system comprising:

at least two product catalogs containing data relating to items such that an item in a first catalog is generally equivalent with an item in a second catalog; and

converting means for converting data relating to said item from said first catalog to data relating to said item from said second catalog.

17. An electronic sourcing system as recited in claim **16**, wherein at least one catalog database contains said data from each of said catalogs, and said converting means includes a non-catalog database containing a cross-reference table such that use of a reference code corresponding to an entry in said cross-reference table links said item from said first catalog to data relating to said item from said second catalog.

18. An electronic sourcing system as recited in claim **16**, wherein one or more catalog databases contain said data from each of said catalogs, and said converting means including one or more catalog databases including an identical reference code corresponding to said data from said first catalog and said data from said second catalog.

19. An electronic sourcing system as recited in claim **16**, wherein said first catalog may be searched separately from said second catalog.

20. An electronic sourcing system as recited in claim **19**, wherein a user lacks access to said first catalog and has access to said second catalog, such that a request for an item in said first catalog provides said data from said second catalog.

21. An electronic sourcing system comprising:

a requisition module including data fields, user-generated criteria entered into at least one of said data fields to generate at least partial criteria corresponding to a desired item;

a catalog collection searching module, said searching module including a collection of catalogs of items stored in an electronic format, a catalog selection criteria used to select less than said entire collection, said searching module being used to generate additional search-module criteria for said data fields of said requisition module;

a multiple purchase order generation module, said purchase order generation module creating multiple purchase orders from a single requisition created with said user-generated criteria and said search-module criteria;

wherein each of at least two catalogs include a generally equivalent item from a different source, said requisition module working in combination with said catalog searching module to determine multiple sources for said item;

wherein said multiple sources is limited by said catalog searching module providing a match according to said user-generated criteria, said search-module criteria and a determination system that located items are generally equivalent; and

wherein said determination system includes a cross reference table matching an identification code from a first located item with a second identification code from a second located item.

22. An electronic sourcing system as recited in claim **21**, wherein said determination system includes an identical identification code for each of said located items.

23. An electronic sourcing system, as recited in claim **21**, wherein said requisition module generates a preferred requisition based on at least one of product availability and user preferences in accordance with a determination of multiple sources for a desired item.

24. An electronic sourcing system as recited in claim **21**, wherein less than said catalog selection criteria is determined by at least one of said user-generated criteria or user characteristics.

25. An electronic sourcing system as recited in claim **24**, wherein said user characteristics include a listing of catalogs from which a user is allowed to purchase.

26. An electronic sourcing module as recited in claim **21**, wherein said requisition module uses at least one predetermined rule to select which of multiple sources to use for said desired item.

27. An electronic sourcing system as recited in claim **26**, wherein said pre-determined rule relies on item availability.

28. An electronic sourcing system as recited in claim **26**, wherein said pre-determined rule relies on a hierarchy of preferred sources.

29. An electronic sourcing system comprising:

a collection of catalogs of items stored in an electronic format;

a first set of pre-determined criteria associated with said collection of catalogs;

a second set of pre-determined criteria associated with items from each of said catalogs;

a catalog selection protocol, said catalog selection protocol relying on said first set of pre-determined criteria to select less than said entire collection of catalogs, and including matching a vendor identification code with a subset of said collection of catalogs, wherein said subset of catalogs includes both a vendor catalog from a predetermined vendor and a second catalog from a predetermined third party;

a search program, said search program relying on said second set of criteria to select specific items from said catalogs determined from said catalog selection protocol; and

a cross-reference table linking a vendor item catalog number from said vendor catalog with an item catalog number from said predetermined third party.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO : 6,055,516
DATED : April 25, 2000
INVENTOR(S) : James M. Johnson et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On title page, item 73 Assignee
replace "Procurenet, Inc."
with --Fisher Scientific Company L.L.C.--.

On title page, item 63 Related U.S. Application Data
please insert --, issued as US Patent No. 6,023,683 on February 8, 2000--.

Col. 1, line 2
please insert --, issued as US Patent No. 6,023,683 on February 8, 2000--.

Signed and Sealed this

First Day of May, 2001

Attest:

Nicholas P. Godici

NICHOLAS P. GODICI

Attesting Officer

Acting Director of the United States Patent and Trademark Office

US006115641A

United States Patent [19]

Brown et al.

[11] Patent Number: 6,115,641

[45] Date of Patent: Sep. 5, 2000

[54] SYSTEMS AND METHODS FOR FACILITATING THE EXCHANGE OF INFORMATION BETWEEN SEPARATE BUSINESS ENTITIES

[75] Inventors: Keith T. Brown; Philip B. Brown; J. William Waddell, all of Durham; Jeffrey J. André , Raleigh, all of N.C.

[73] Assignee: BuildNet, Inc., Durham, N.C.

[21] Appl. No.: 09/083,453

[22] Filed: May 22, 1998

Related U.S. Application Data

[62] Division of application No. 08/775,276, Dec. 31, 1996, Pat. No. 5,923,552.

[51] Int. Cl.[7] G06F 19/00; G06F 17/60

[52] U.S. Cl. 700/102; 705/27; 705/26; 705/28

[58] Field of Search 705/27, 26, 28; 700/102

[56] References Cited

U.S. PATENT DOCUMENTS

4,700,318	10/1987	Ockman	345/431
4,852,001	7/1989	Tsushima et al.	705/8
4,937,743	6/1990	Rassman et al.	705/8
5,053,970	10/1991	Kurihara et al.	700/104
5,233,533	8/1993	Edstrom et al.	700/103
5,255,181	10/1993	Chapman et al.	705/8
5,283,865	2/1994	Johnson	345/357
5,319,542	6/1994	King, Jr. et al.	705/27
5,367,627	11/1994	Johnson	345/357
5,369,570	11/1994	Parad	705/8
5,381,332	1/1995	Wood	705/8
5,406,476	4/1995	Deiziel, Jr. et al.	705/8
5,450,317	9/1995	Lu et al.	705/10
5,467,268	11/1995	Sisley et al.	705/9
5,487,144	1/1996	Takahashi et al.	345/348
5,493,490	2/1996	Johnson	705/26
5,548,506	8/1996	Srinivasan	705/8
5,548,518	8/1996	Dietrich et al.	700/100
5,694,546	12/1997	Reisman	705/26

FOREIGN PATENT DOCUMENTS

0466 089 A2	1/1992	European Pat. Off. .
2 293 902A	4/1996	United Kingdom .
WO 95/33236	12/1995	WIPO .

OTHER PUBLICATIONS

Brown, Keith T., *The Builder's Revolution*, pp. 185–257, ISBN: 0–9649339–)–X, Sun Forest systems Publishing (1995).

Leuthold, Jrm, *CPM scheduling is key to project efficiency; critical path method; Construction Management Column*, vol. 69, No. 5, p. 43, ISSN: 0033–4801, Pulp & paper, Miller Freemans Inc. (1995).

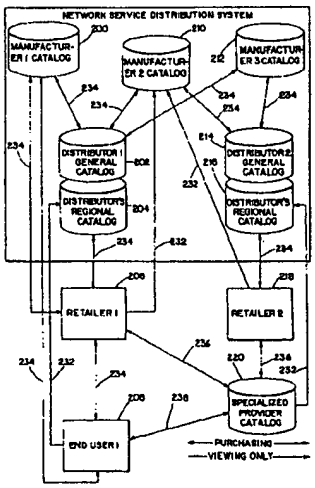
Valigra, Lori, *Saturn's NT Effect*, vol. 3,No. 6, p. 040, Client/Sewer Computing, Senting Publishing Co. (1996).

Primary Examiner—William Grant
Assistant Examiner—Zoila Cabrera
Attorney, Agent, or Firm—Myers Bigel Sibley & Sajovec, P.A.

[57] ABSTRACT

A computer based product catalog system is provided for automatically distributing product information to members of a network. Electronically stored catalogs of multiple manufacturers' products, including descriptions of the products, are provided. An electronically stored distributor catalog, including selected products from the various manufacturers is also provided. Descriptions of the products in the manufacturers' catalogs may be updated automatically. In response to the updating of the manufacturers' catalogs, the descriptions of the products in the distributor's catalog may be automatically updated in real time. A terminal located at the retail level of distribution may be operatively connected to the manufacturers' catalogs and to the distributor catalog to allow viewing of product information therewithin. The terminal may enable users to order products from a manufacturer's and distributor's catalog.

2 Claims, 11 Drawing Sheets



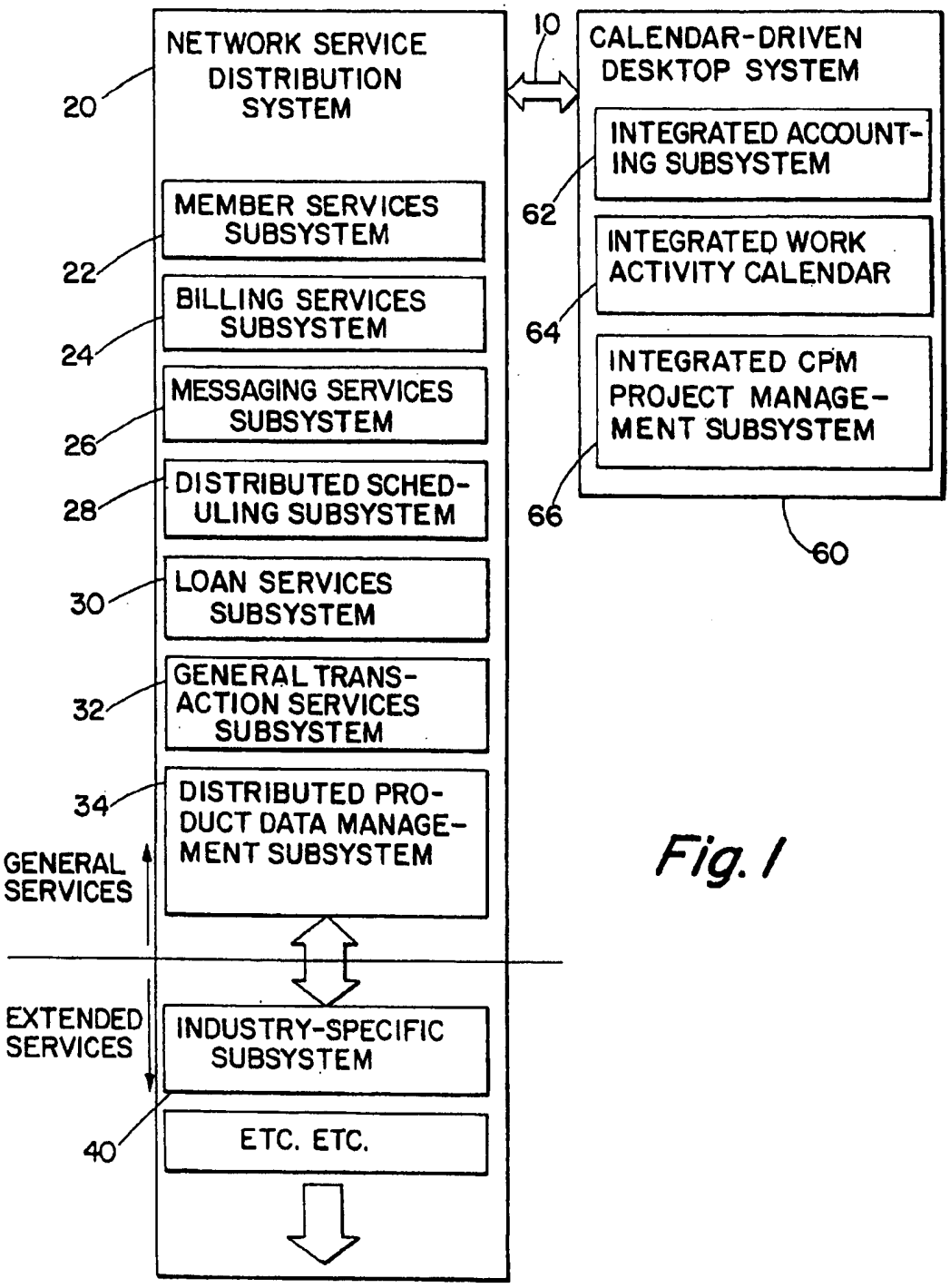

NETWORK SERVICE DISTRIBUTION SYSTEM
20
MEMBER SERVICES SUBSYSTEM
22
BILLING SERVICES SUBSYSTEM
24
MESSAGING SERVICES SUBSYSTEM
26
DISTRIBUTED SCHEDULING SUBSYSTEM
28
LOAN SERVICES SUBSYSTEM
30
GENERAL TRANSACTION SERVICES SUBSYSTEM
32
DISTRIBUTED PRODUCT DATA MANAGEMENT SUBSYSTEM
34
GENERAL SERVICES
EXTENDED SERVICES
INDUSTRY-SPECIFIC SUBSYSTEM
ETC. ETC.
40
10
CALENDAR-DRIVEN DESKTOP SYSTEM
INTEGRATED ACCOUNTING SUBSYSTEM
62
INTEGRATED WORK ACTIVITY CALENDAR
64
INTEGRATED CPM PROJECT MANAGEMENT SUBSYSTEM
66
60

Fig. 1

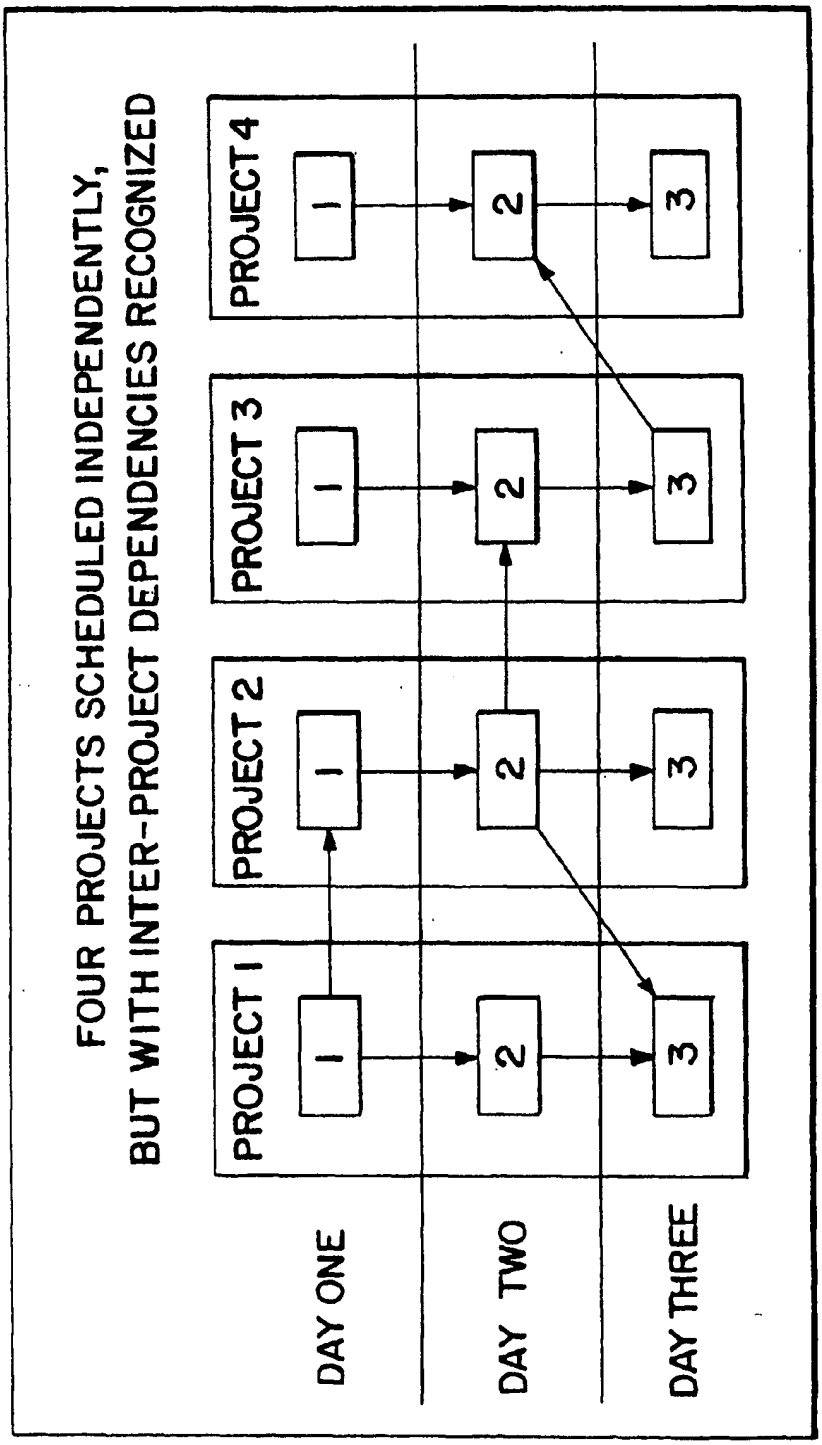

FOUR PROJECTS SCHEDULED INDEPENDENTLY,
BUT WITH INTER-PROJECT DEPENDENCIES RECOGNIZED
PROJECT 1
PROJECT 2
PROJECT 3
PROJECT 4
1
2
3
DAY ONE
DAY TWO
DAY THREE

Fig. 2A

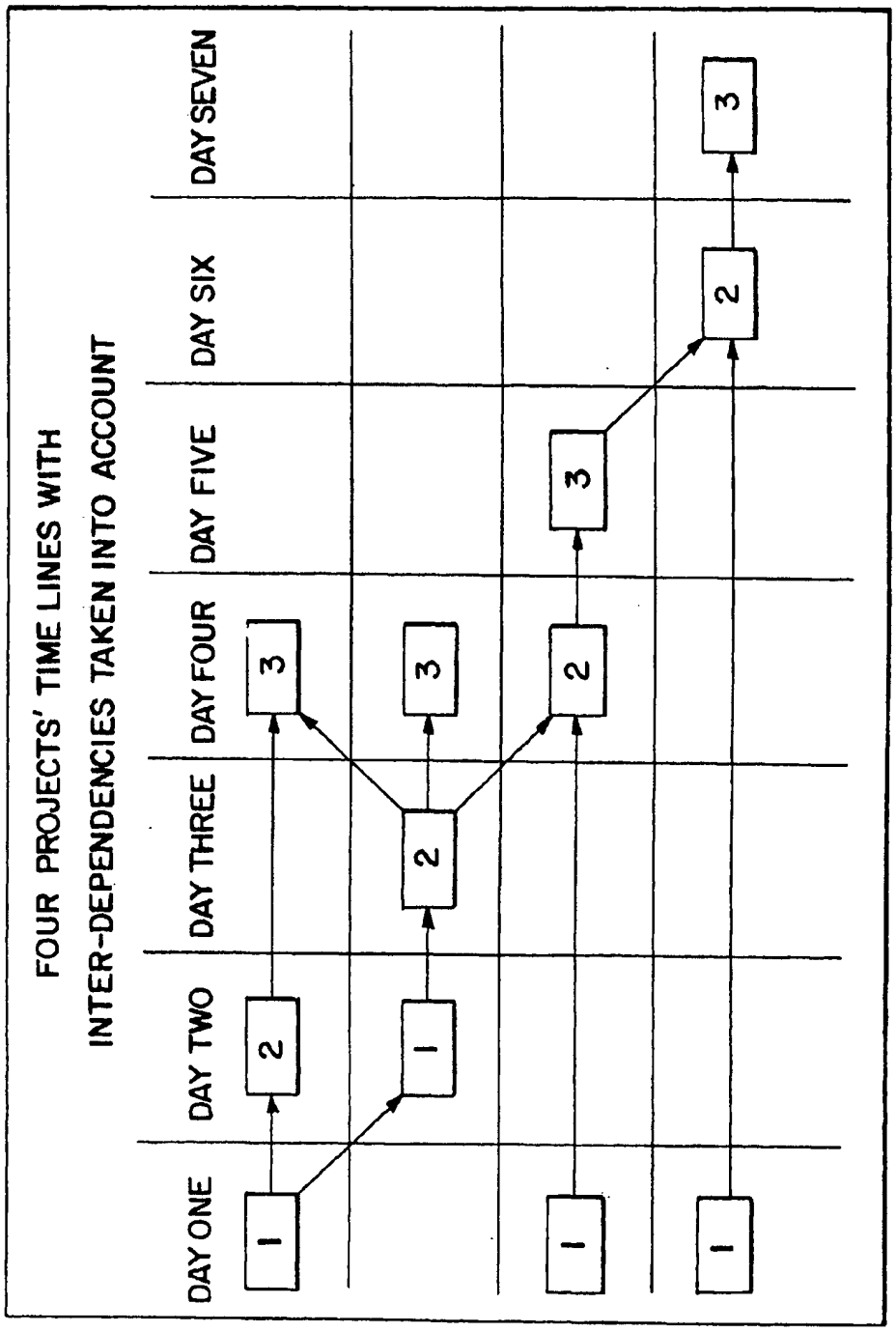

FOUR PROJECTS' TIME LINES WITH
INTER-DEPENDENCIES TAKEN INTO ACCOUNT
DAY ONE
DAY TWO
DAY THREE
DAY FOUR
DAY FIVE
DAY SIX
DAY SEVEN
1
2
1
2
3
3
1
2
1
3
2
3

Fig. 2B

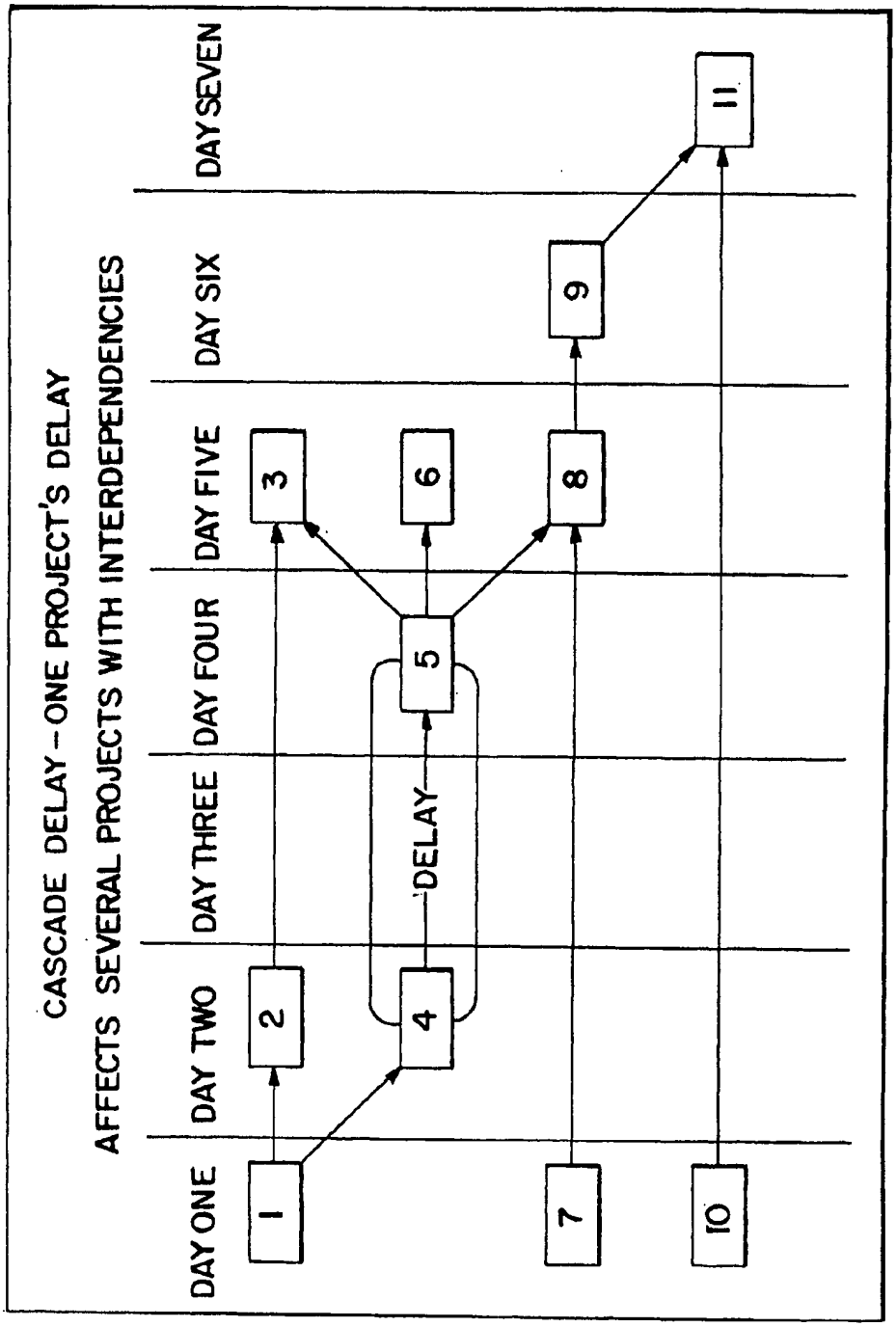

CASCADE DELAY – ONE PROJECT'S DELAY
AFFECTS SEVERAL PROJECTS WITH INTERDEPENDENCIES
DAY ONE
DAY TWO
DAY THREE
DAY FOUR
DAY FIVE
DAY SIX
DAY SEVEN
DELAY
1
2
3
4
5
6
7
8
9
10
11

Fig. 2C

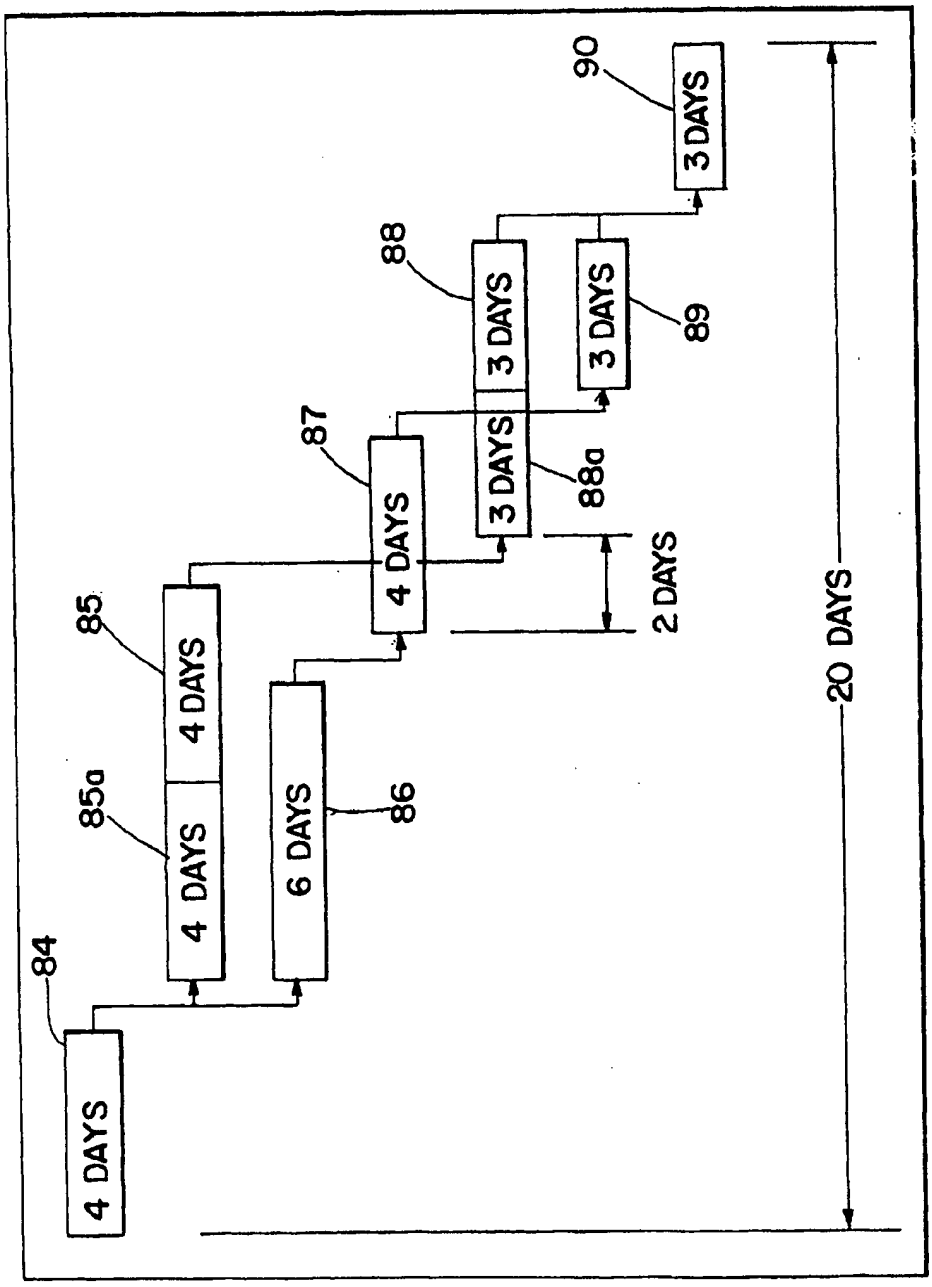

4 DAYS
84
4 DAYS
85a
4 DAYS
85
6 DAYS
86
4 DAYS
87
3 DAYS
88a
3 DAYS
88
3 DAYS
89
3 DAYS
90
2 DAYS
20 DAYS

Fig. 3A

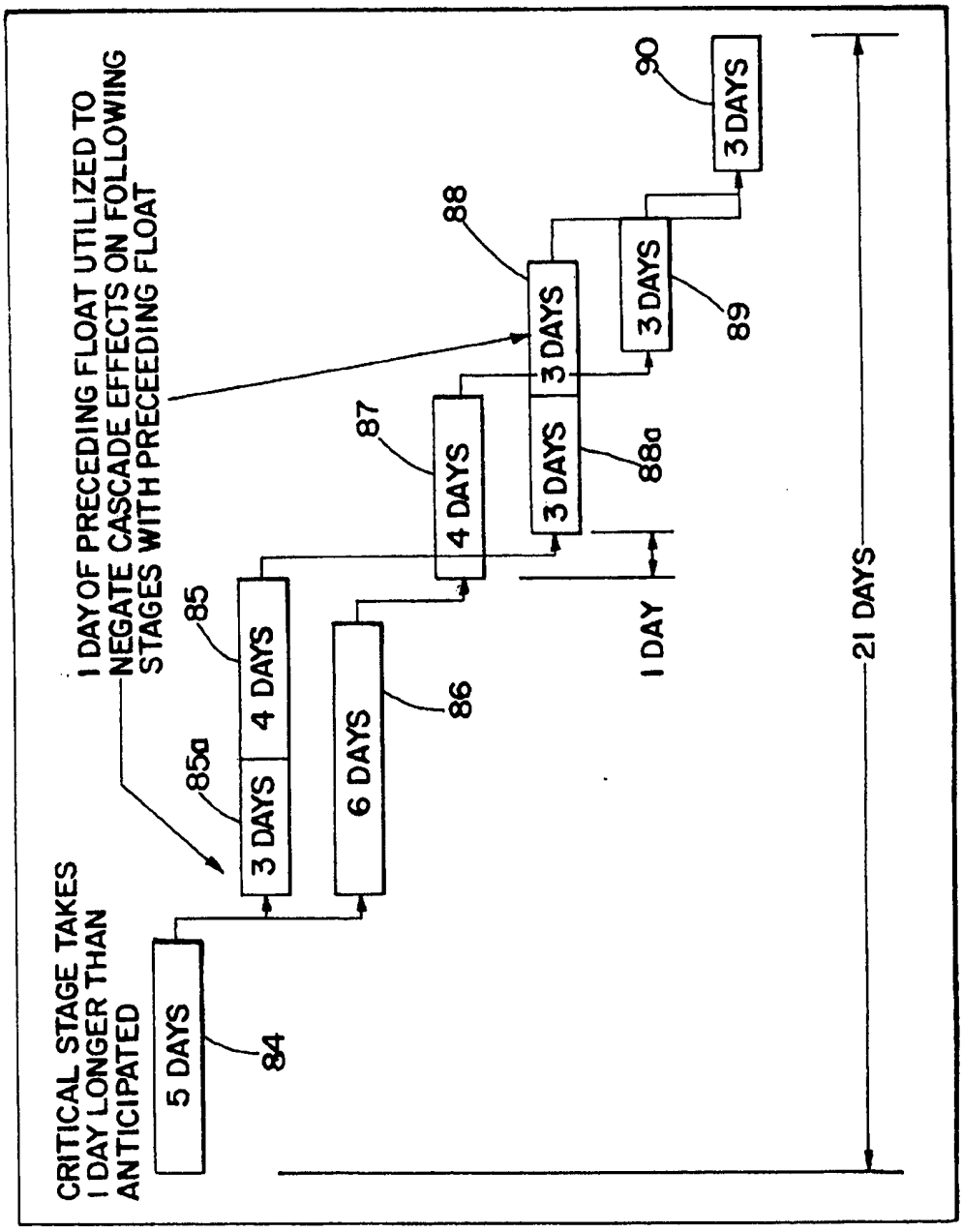

CRITICAL STAGE TAKES
1 DAY LONGER THAN
ANTICIPATED
5 DAYS
84
3 DAYS
85a
4 DAYS
85
6 DAYS
86
1 DAY OF PRECEDING FLOAT UTILIZED TO
NEGATE CASCADE EFFECTS ON FOLLOWING
STAGES WITH PRECEEDING FLOAT
4 DAYS
87
3 DAYS
88
3 DAYS
88a
1 DAY
3 DAYS
89
3 DAYS
90
21 DAYS

Fig. 3B

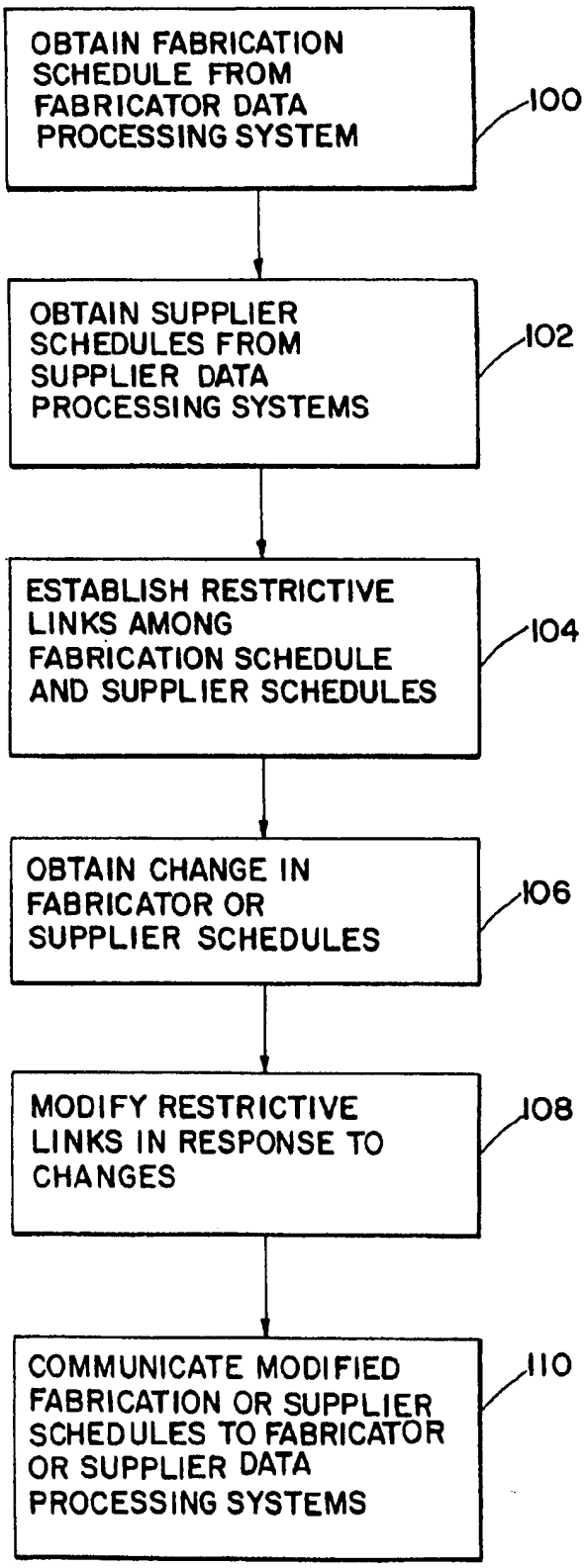

OBTAIN FABRICATION SCHEDULE FROM FABRICATOR DATA PROCESSING SYSTEM
100
OBTAIN SUPPLIER SCHEDULES FROM SUPPLIER DATA PROCESSING SYSTEMS
102
ESTABLISH RESTRICTIVE LINKS AMONG FABRICATION SCHEDULE AND SUPPLIER SCHEDULES
104
OBTAIN CHANGE IN FABRICATOR OR SUPPLIER SCHEDULES
106
MODIFY RESTRICTIVE LINKS IN RESPONSE TO CHANGES
108
COMMUNICATE MODIFIED FABRICATION OR SUPPLIER SCHEDULES TO FABRICATOR OR SUPPLIER DATA PROCESSING SYSTEMS
110

Fig. 4

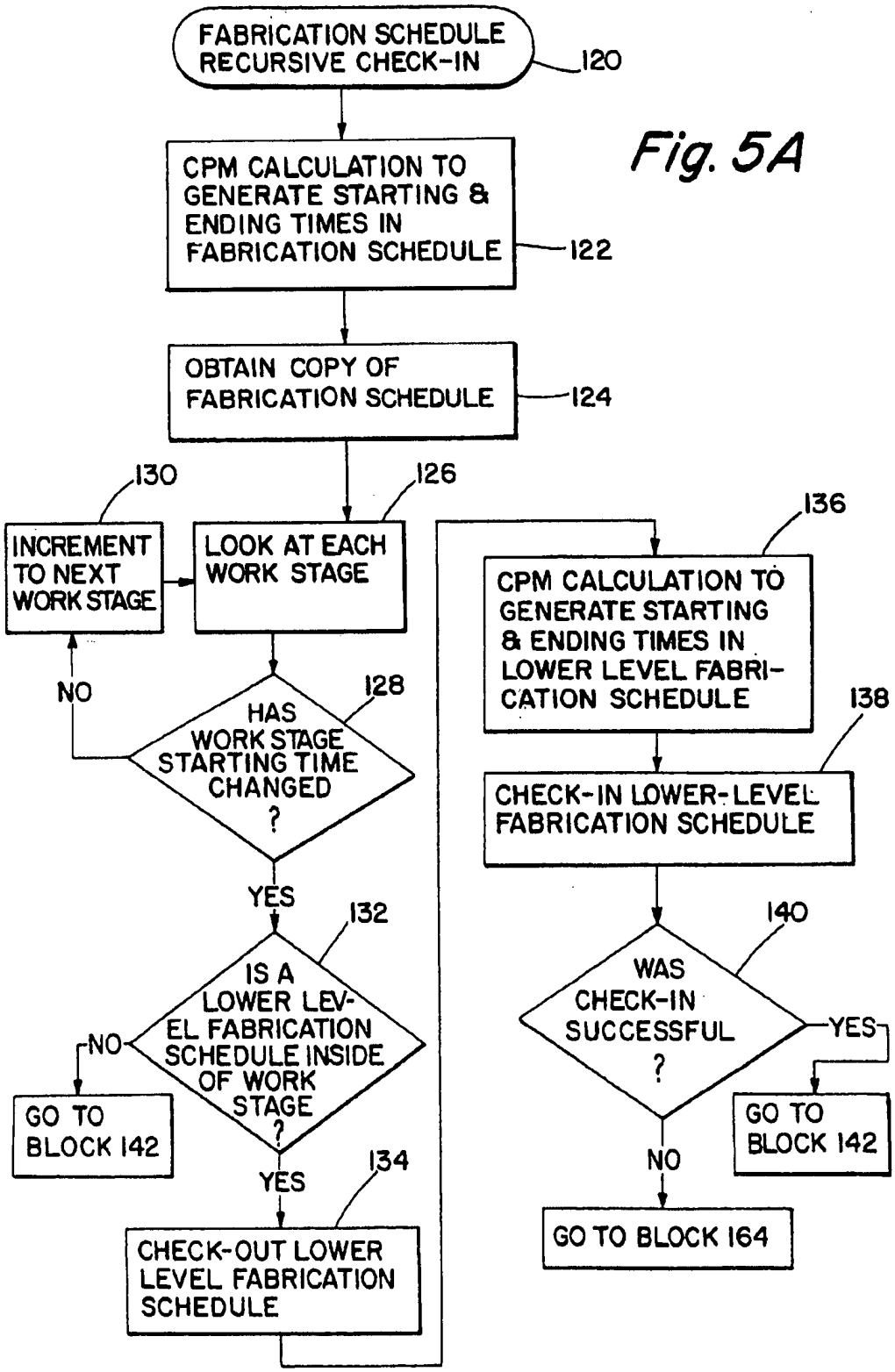

FABRICATION SCHEDULE RECURSIVE CHECK-IN
120
CPM CALCULATION TO GENERATE STARTING & ENDING TIMES IN FABRICATION SCHEDULE
122
OBTAIN COPY OF FABRICATION SCHEDULE
124
130
126
INCREMENT TO NEXT WORK STAGE
LOOK AT EACH WORK STAGE
NO
HAS WORK STAGE STARTING TIME CHANGED ?
128
YES
132
IS A LOWER LEVEL FABRICATION SCHEDULE INSIDE OF WORK STAGE ?
NO
GO TO BLOCK 142
YES
134
CHECK-OUT LOWER LEVEL FABRICATION SCHEDULE
136
CPM CALCULATION TO GENERATE STARTING & ENDING TIMES IN LOWER LEVEL FABRICATION SCHEDULE
138
CHECK-IN LOWER-LEVEL FABRICATION SCHEDULE
140
WAS CHECK-IN SUCCESSFUL ?
YES
GO TO BLOCK 142
NO
GO TO BLOCK 164

Fig. 5A

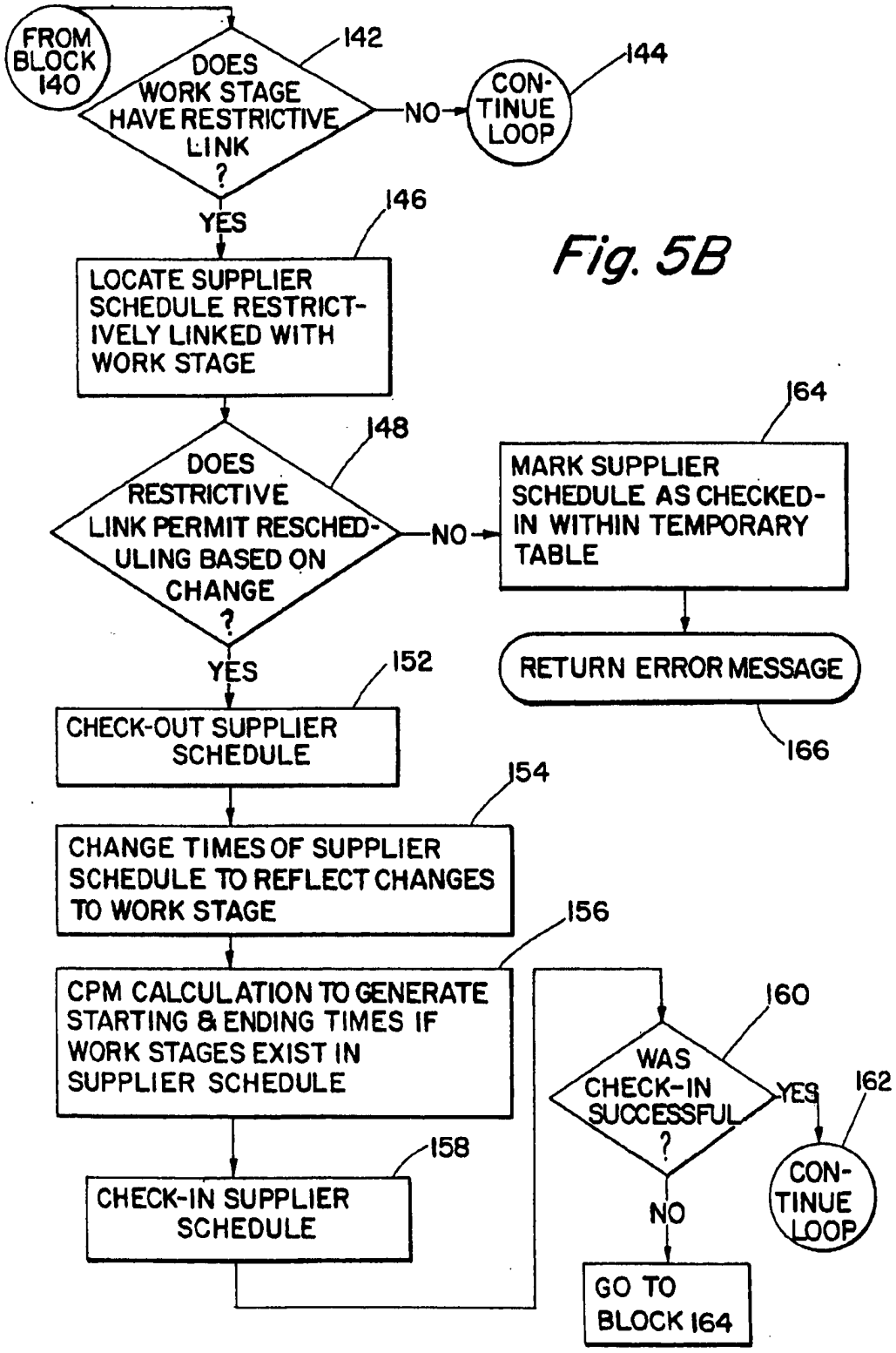

FROM BLOCK 140
142
DOES WORK STAGE HAVE RESTRICTIVE LINK ?
NO
144
CON-TINUE LOOP
YES
146
LOCATE SUPPLIER SCHEDULE RESTRICT-IVELY LINKED WITH WORK STAGE
148
DOES RESTRICTIVE LINK PERMIT RESCHED-ULING BASED ON CHANGE ?
NO
164
MARK SUPPLIER SCHEDULE AS CHECKED-IN WITHIN TEMPORARY TABLE
RETURN ERROR MESSAGE
166
YES
152
CHECK-OUT SUPPLIER SCHEDULE
154
CHANGE TIMES OF SUPPLIER SCHEDULE TO REFLECT CHANGES TO WORK STAGE
156
CPM CALCULATION TO GENERATE STARTING & ENDING TIMES IF WORK STAGES EXIST IN SUPPLIER SCHEDULE
158
CHECK-IN SUPPLIER SCHEDULE
160
WAS CHECK-IN SUCCESSFUL ?
YES
162
CON-TINUE LOOP
NO
GO TO BLOCK 164

Fig. 5B

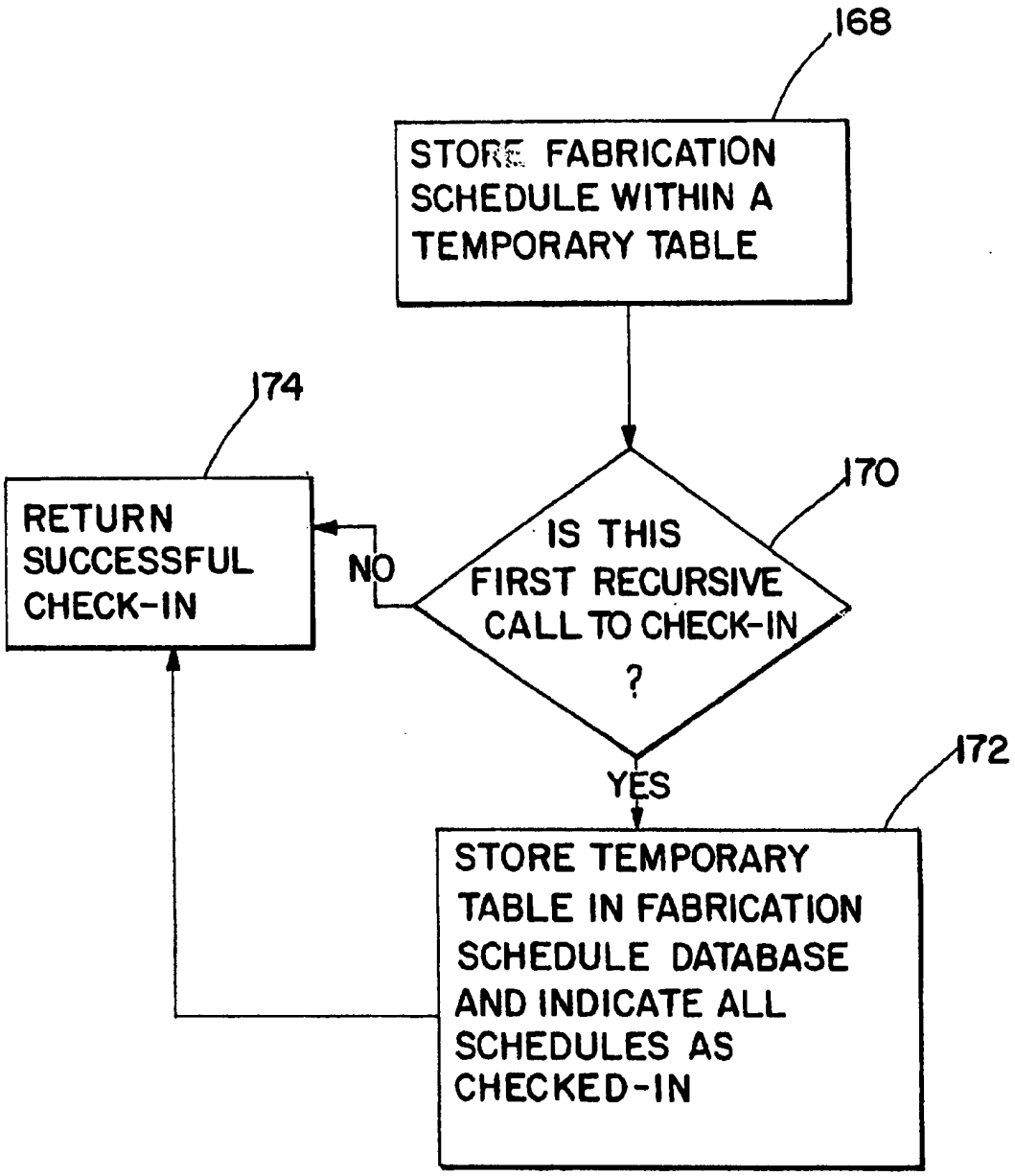

168
STORE FABRICATION SCHEDULE WITHIN A TEMPORARY TABLE
174
RETURN SUCCESSFUL CHECK-IN
NO
170
IS THIS FIRST RECURSIVE CALL TO CHECK-IN ?
YES
172
STORE TEMPORARY TABLE IN FABRICATION SCHEDULE DATABASE AND INDICATE ALL SCHEDULES AS CHECKED-IN

Fig. 5C

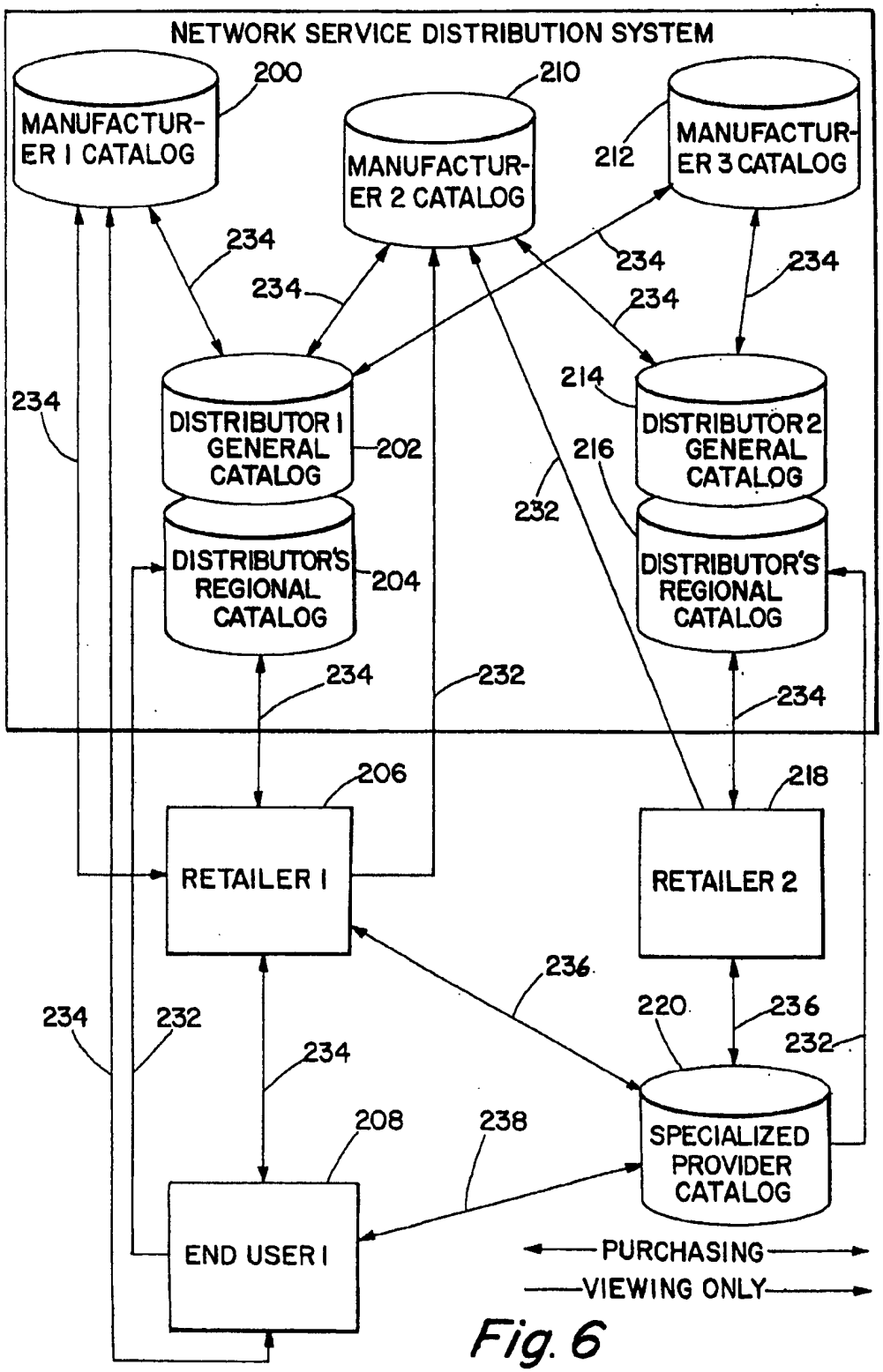

NETWORK SERVICE DISTRIBUTION SYSTEM
MANUFACTURER 1 CATALOG
200
MANUFACTURER 2 CATALOG
210
MANUFACTURER 3 CATALOG
212
234
DISTRIBUTOR 1 GENERAL CATALOG
202
DISTRIBUTOR 2 GENERAL CATALOG
214
216
232
DISTRIBUTOR'S REGIONAL CATALOG
204
206
218
RETAILER 1
RETAILER 2
236
220
208
238
SPECIALIZED PROVIDER CATALOG
END USER 1
PURCHASING
VIEWING ONLY

Fig. 6

SYSTEMS AND METHODS FOR FACILITATING THE EXCHANGE OF INFORMATION BETWEEN SEPARATE BUSINESS ENTITIES

CROSS REFERENCE TO RELATED APPLICATION

This application is a divisional of application Ser. No. 08/775,276, filed Dec. 31, 1996, now U.S. Pat. No. 5,923,552.

FIELD OF THE INVENTION

The present invention relates generally to electronic communications and more particularly to electronic communications via computer networks.

BACKGROUND OF THE INVENTION

Electronic communications via computer networks are replacing traditional modes of communication including printed media and voice communication. One form of computer network communication, known as Electronic Data Interchange (EDI), is becoming a standard format for exchanging information within a business. However, the use of network communications such as EDI as a means for communicating between separate business entities has not received widespread acceptance because of the independent nature of the computer networks of separate business entities.

Computer networks have also been used within a business to implement various quantitative analysis techniques such as Critical Path Method (CPM) scheduling, Project Evaluation and Review Technique (PERT) and Material Requirement Planning (MRP). These tools are used to increase the efficiency of business operations and to coordinate work flow within a business. For example, U.S. Pat. No. 5,233,533 to Edstrom et al. describes scheduling software for optimizing the scheduling of resources in a factory setting. U.S. Pat. No. 4,937,743 to Rassman et al., describes a method for the dynamic management of a project involving multiple interrelated resources, such as the use of facilities and equipment within a business entity. Unfortunately, the independent nature of many computer networks and the programs designed to run on these computer systems, has made the coordination of schedules between separate business entities difficult. Consequently, computer systems have often not been used to facilitate the scheduling of interrelated operations of individual business entities across an entire industry.

Product information is often transmitted by manufacturers to distributors in an electronic format. Because product distributors typically sell products from multiple manufacturers, each distributor typically develops its own catalog of products using the information provided by the various manufacturers. As a result, updated product information received from a manufacturer is not easily or promptly forwarded to retailers and others who purchase products from distributors because the distributor must update its catalog.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to facilitate communication and information exchange between independent business entities.

It is another object of the present invention to facilitate the coordination of schedules of individual business entities within an industry.

It is another object of the present invention to facilitate prompt dissemination of product information from manufacturers to others downstream in the distribution chain.

The present invention includes systems, methods, and computer program products for synchronizing fabrication schedules and supplier schedules. A fabrication schedule includes a plurality of sequential work stages which are stored on a fabricator data processing system. Supplier schedules include a plurality of schedules for the sequential work stages within a fabrication schedule. Supplier schedules may be stored on supplier data processing systems. A fabrication schedule is obtained from a fabricator data processing system, and supplier schedules are obtained from respective supplier data processing systems. Restrictive links are established between the fabrication schedule and the supplier schedules. Each restrictive link defines the supplier that will perform a work stage, and may also define the starting and ending times for both fabrication and supplier schedules.

When a change in at least one of the sequential work stages is obtained from the fabricator or from the selected one of the suppliers, the restrictive links are automatically modified in response to the obtained change. The modified fabrication schedule and/or the modified supplier schedule is communicated to the fabricator data processing system or to the supplier data processing system. If a restrictive link cannot be modified in response to an obtained change, an error message may be returned. Furthermore, if a supplier is not able to supply a particular work stage, a second supplier may be automatically selected.

The present invention facilitates synchronizing relevant portions of a product fabricator's schedules with the various schedules of suppliers of materials, labor, and the like. The present invention also facilitates the synchronization of accounting and billing systems, access to product-related information, access to legislative and regulatory information, and access to on-line catalogs and ordering systems for various materials.

According to another aspect of the present invention, a scheduling method is provided for reducing the time to complete a critical path schedule when completion of at least one of the activities in the critical path is delayed. A schedule having interrelated activities forming a critical path is stored in a data processing system. A float time preceding a selected activity starting time is assigned and utilized to absorb delays in completing activities preceding the selected activity. A revised schedule may be generated in the data processing system based upon the absorbed delays. Float time may be assigned to multiple selected activities.

According to another aspect of the present invention, a computer based product catalog system is provided for automatically distributing product information. Electronically stored catalogs of multiple manufacturers' products, including descriptions of the products, are provided. An electronically stored distributor catalog, including selected products from the various manufacturers is also provided. Descriptions of the products in the manufacturers' catalogs may be updated automatically. In response to the updating of the manufacturers' catalogs, the descriptions of the products in the distributor's catalog may be automatically updated. A terminal located at the retail level of distribution may be operatively connected to the manufacturers' catalogs and to the distributor catalog to allow viewing of product information therewithin. The terminal may enable users to order products from a manufacturer's and distributor's catalog.

The present invention is advantageous because it facilitates the coordination and flow of information between

separate business entities within an industry. In particular, schedules of separate business entities can be synchronized to establish efficiencies across the industry. The present invention enhances the flow of information among businesses without disrupting the autonomy of each business. Furthermore, the present invention allows information to flow between the members of an industry without interfering with the established channels of trade and business relationships.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a Network Service Distribution System and a Calendar-Driven Desktop System for synchronizing schedules and exchanging information between separate business entities, according to the present invention.

FIGS. **2A**, **2B**, **2C** illustrate the interdependencies of multiple projects.

FIGS. **3A**, **3B** illustrate adding preceding float time to various work stages in a CPM schedule, according to the present invention.

FIG. **4** schematically illustrates a method of synchronizing a fabrication schedule and a plurality of supplier schedules, according to the present invention.

FIGS. **5A**, **5B**, **5C** schematically illustrate in greater detail a method of synchronizing a fabrication schedule and a plurality of supplier schedules.

FIG. **6** illustrates a computer based product catalog system for distributing product information, according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention now is described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

According to one aspect of the present invention, a computer network system having a dynamic scheduling system for integrating schedules of separate business entities within an industry is disclosed. The present invention leaves the independence and management of individual business entities intact, yet allows the whole industry to work as a single, efficient organization. Utilizing the present invention, a business entity may view and interact with information of other members an entire industry. Each business continues to compete with other businesses in the industry, yet scheduling of activities, project management and exchange of information necessary for the whole industry to function can become organized and efficient via the present electronic computer network system. To facilitate scheduling and project management across an entire industry, the present invention utilizes and enhances known scheduling techniques including Critical Path Method (CPM) to allow each network member to maintain individual schedules yet synchronize relevant portions of these schedules with the schedules of other industry members.

Using the home building industry as an illustrative example, the present invention facilitates synchronizing relevant portions of a home builder's schedules with the various schedules of vendors, suppliers, manufacturers, financial institutions, and the like. The present invention also facilitates the synchronization of accounting and billing systems, access to home building-related information, access to legislative and regulatory information, and access to on-line catalogs and ordering systems for materials, fixtures, and the like.

For each individual house being fabricated by a home builder, the home builder typically will develop a fabrication schedule which includes a sequential listing of all activities or work stages related to the completion and sale of the house. For example, work stages may include, but are not limited to, grading the lot upon which a house is to be built, digging the foundation, pouring the footings upon which the house rests, framing the structure, placing a roof over the framing, covering the framing with sheathing, laying up brick veneer, and finishing the inside of the house. Each of these work stages will typically be assigned starting times and will be sequentially arranged so that the house is built in the shortest amount of time. As is known to those having skill in the art, some work stages may occur substantially concurrently, while others require the completion of a preceding work stage before they can occur.

The home builder will typically enter into a relationship or contract with another party, such as a sub-contractor or material supplier to perform the work and/or deliver materials for each of these work stages. In either case, the contracting party is a supplier of either labor or materials or both. Each contract between the home builder and a supplier of labor/materials typically includes a time of performance on the part of the supplier. That is, each contract will restrictively link the supplier's schedule of performance to the home builder's schedule for a particular house. Because most suppliers of labor/materials are supplying labor/materials for multiple houses and projects, it is important that a home builder's schedule for a particular house be synchronized with a supplier's schedule. In particular, it is important for a home builder to know that if a work stage starting date is changed for some reason, the supplier supplying labor/materials for that work stage either can or cannot perform under the contract. If the supplier cannot perform because of its schedules related to other projects, the home builder must secure a contract with another supplier.

An exemplary work stage during the construction of a house is the framing of the house structure. A home builder will typically locate a particular supplier (i.e. a framing crew) to begin and complete the framing work stage within a given time period. For example, assume that framing of a particular house is slated to take twenty days beginning on January 1. The home builder enters into a contract with framing crew A to begin framing on January 1 and complete framing no later than January 21. Typically, the contract or restrictive link between the home builder and framing crew A will include some reasonable time range in which the starting date of framing can vary, such as plus or minus three days. Thus, if the foundation work, which must be completed prior to framing, is not completed until January 2, the home builder knows that framing crew A can still perform. However, if the foundation work is not completed until January 18, the contract between the home builder and framing crew A is no longer valid and the home builder must either ask framing crew A if it can still perform, or the home builder must look for another framing crew.

The above scenario is often repeated in the home building industry and other fabrication industries many times during a single project. The home builder or other product fabricator typically spends a lot of time securing contracts with

suppliers of labor/materials, both at the beginning of a fabrication schedule and throughout the schedule as the starting and ending times of the various work stages are changed. The present invention facilitates establishing contracts or restrictive links between product fabricators, such as home builders, and suppliers of labor and/or materials. The present invention also facilitates the automatic synchronization of a fabricator's schedule for a particular project or product with the schedules of many suppliers of labor and/or materials as changes occur to either the fabricator's schedule or a supplier's schedule or both. The present invention also facilitates rescinding a contract between a fabricator and a supplier when the rescinded contract does not permit a particular change to either the fabrication schedule or the supplier's schedule, and facilitates the establishment of a replacement contract between the fabricator and another supplier. The present invention may be utilized in a variety of industries and is not limited to the home building industry.

A preferred computer network system for carrying out methods of synchronizing a fabrication schedule with a plurality of supplier schedules, according to the present invention, is a dynamic system wherein schedule changes made by a network member ripple down to all network members and are automatically integrated within the schedule of each respective network member as appropriate. For example, if rain delays the framing of a house, the lumber yard's delivery schedule will be updated automatically to deliver lumber on a new date specified in the home builder's schedule. The present invention permits such changes to be made remotely through the use of various input devices, including personal data assistants and other computer terminals in communication with a central data processing system.

Referring now to FIG. **1**, a computer network system **10** for synchronizing schedules and facilitating the flow of information between multiple business entities within an industry, according to a preferred embodiment of the present invention, is illustrated. In the illustrated embodiment, the computer network system **10** includes a centrally-located Network Service Distribution System **20** and a plurality of Calendar-Driven Desktop Systems **60**, each in communication with the Network Service Distribution System. Each Calendar-Driven Desktop System **60** is the user interface members of the computer network system **10** use to communicate and exchange information with other network members via the Network Service Distribution System **20**. The Network Service Distribution System **20** and each Calendar-Driven Desktop System **60** contain subsystems that are described in detail below.

Network Service Distribution System

The Network Service Distribution System **20** contains the following subsystems that may apply generally to any industry: Member Services Subsystem **22**, Billing Services Subsystem **24**, Messaging Services Subsystem **26**, Distributed Scheduling Subsystem **28**, Loan Services Subsystem **30**, General Transaction Services Subsystem **32**, Distributed Product Data Management Subsystem **34**, and a Consumer Product or Service Marketing Subsystem (not shown). These subsystems can be categorized as general services, as illustrated, because they are typically useful and important to any industry. In addition, one or more, industry-specific subsystems **40** can be added as necessary. Industry-specific subsystems **40** can be categorized as extended services, as illustrated, because they are typically unique to a particular industry.

The Member Services Subsystem **22** and the Billing Services Subsystem **24** are used to maintain information about network members. The term "network members" shall mean business entities within an industry that have access to the computer network system **10** illustrated in FIG. **1**, or a computer network system capable of carrying out the methods of the present invention. It is contemplated by the present invention that each network member is a distinct and separate business entity within a particular industry. The Member Services Subsystem **22** preferably maintains the list of network members and validates the identity of a user in communication with the Network Service Distribution System **20**. The Billing Services Subsystem **24** preferably tracks the usage of the Network Service Distribution System **20** for each network member and generates billing information for each network member. The Messaging Services Subsystem **26** is used to store and forward electronic mail and other asynchronous message types between network members. Preferably, various publications and discussion forums are accessible by network members via the Messaging Services Subsystem **26**. Also, gateways are preferably provided to the Internet and other electronic networks for inter-industry information exchange. The Distributed Scheduling Subsystem **28**, described in greater detail below allows each network member to integrate its schedules within the schedules of other network members.

The Loan Services Subsystem **30** facilitates access to financial services for network members and their customers. Preferably, communication with major financial institutions is available via the Loan Service Subsystem **30**. The General Transaction Services Subsystem **32** facilitates a store and forward process for standardized messages that routinely travel between network members in the course of conducting commerce. Exemplary messages include standardized accounting messages and standardized project management messages. Preferably, all messages passing through are stored for audit trail purposes. The Distributed Product Data Management Subsystem **34** makes available electronically recorded product information to distributors, retailers, and consumers. The Consumer Product or Service Marketing Subsystem (not shown) connects network members with consumers and facilitates "on-line" shopping.

The Network Service Distribution System **20** and its illustrated subsystems may serve as a means for: obtaining a fabrication schedule from a fabricator's data processing system; obtaining supplier schedules from respective supplier data processing systems; automatically selecting a supplier from a plurality of suppliers; and communicating a selection to the supplier system which corresponds to the selected supplier. The Network Service Distribution System **20** may also include a fabricator data processing system for storing fabrication schedules which include multiple work stages arranged sequentially. The Network Service Distribution System **20** may also include a plurality of supplier data processing systems for storing a schedule for each sequential work stage performed by a particular supplier.

Calendar-Driven Desktop System

The Calendar-Driven Desktop System **60** provides the network interface for communications with the Network Service Distribution System **20** and with other network members. It also provides users with a calendar of tasks and work stages needed for carrying out the operations of a network member's business. Standardized messages from the General Transaction Services Subsystem **32** can automatically produce intelligent calendar entries. These calendar entries may be employed to launch applications when selected, or they can automatically launch on a given date. Calendar entries can likewise be used to send standardized

messages back to the General Transaction Services Subsystem or can send them automatically **32**.

Using the home building industry as an example, when it is time to order supplies for a given work stage of a project, a calendar entry created by a project management or project planning application can automatically place the order. Calendar entries can also automatically confirm that an order will be delivered on time. Recurring calendar entries can be used to launch recurring applications or functions appropriate for a network member's business. Calendar entries may be used to integrate project management, integrate work activity calendars, and integrate accounting. For project management, calendar entries can issue purchase orders and bid requests, or ask for confirmation regarding material delivery. For accounting, calendar entries can be used to send and receive invoices. Any subsystem application can be written under the Calendar-Driven Desktop System **60** to provide that particular application with industry-wide communication through the Network Service Distribution System **20** utilizing a standardized application programming interface (API).

In the illustrated embodiment of FIG. **1**, the Calendar-Driven Desktop System **60** includes the following: Integrated Accounting Subsystem **62**, Integrated Work Activity Calendar **64**, and Integrated Project Management Subsystem **66**. The Calendar-Driven Desktop System **60** receives and sends messages between network members and the various subsystems within the Network Service Distribution System **20**. Each message is received and distributed within the Calendar-Driven Desktop **60** according to the subsystem or program application most appropriate to its purpose. For example, messages from the General Transaction Services Subsystem **32** arrive as stages of work or tasks linked to the Integrated Accounting Subsystem **62**. These messages appear as calendar entries requiring attention by a network member. Preferably, calendar entries are automatically entered and adjusted by the Integrated Accounting Subsystem **62** and Integrated Project Management Subsystem **66**. Calendar entries or messages from the General Transaction Services Subsystem **32** may automatically launch appropriate applications associated with completing or resolving the specific type of standardized message.

The Calendar-Driven Desktop System **60**, and its illustrated subsystems, may serve as a means for: obtaining a fabrication schedule from a fabricator's data processing system; obtaining supplier schedules from respective supplier data processing systems; automatically selecting a supplier from a plurality of suppliers; and communicating a selection to the supplier system which corresponds to the selected supplier. The Calendar-Driven Desktop System **60** may also include a fabricator data processing system for storing fabrication schedules which include multiple work stages arranged sequentially. The Calendar-Driven Desktop System **60** may also include a plurality of supplier data processing systems for storing a schedule for each sequential work stage performed by a particular supplier.

The Integrated Project Management Subsystem **66** is a network member's interface with the Network Service Distribution System **20** for fabrication and supplier project schedules, such as CPM schedules. Using the home building industry as an example, a home builder may use the Integrated Project Management Subsystem **66** to obtain, modify, and communicate to suppliers its fabrication schedule. Similarly, each supplier of labor and/or materials may use the Integrated Project Management Subsystem **66** to obtain, modify, and communicate its schedules. The Integrated Work Activity Calendar **64** is a network member's interface with the Network Service Distribution System **20** for work activity calendar schedules. The Integrated Project Management system **66** and the Integrated Work Activity Calendar **64** can both generate bid requests to other network members via the General Transaction Services Subsystem **32** for the purpose of establishing contracts between network members. If bid requests are accepted, contracts can be established using the General Transaction Services Subsystem **32**. Once a contract is established, the Distributed Scheduling Subsystem **28** may serve as a means for establishing restrictive links between the schedules of the contracting parties. Network members may utilize the Calendar-Division Desktop System **60** on an on-going basis to monitor and update work progress on particular projects. When network members indicate that a work stage or task is complete, the restrictive link may be removed by the Distributed Scheduling Subsystem **28**.

An Integrated Accounting Subsystem **62** is preferably integrated with project management and work activity. schedules of a network member such that accounting information is automatically obtained without redundant data entry. Distributed scheduling and project management, along with the General Transaction Services Subsystem **32**, allows the Integrated Accounting Subsystem **62** of the Calendar-Driven Desktop System **60** to function with little or no data entry. Accordingly, the majority of normal functions required for bookkeeping, such as invoice entry, may be eliminated.

The Integrated Work Activity Calendar Subsystem **64** is used by suppliers who enter into contracts with other network members to supply labor and/or materials for a work stage of a fabrication schedule. The Integrated Work Activity Calendar Subsystem **64** facilitates receiving bid requests for the supply of labor and/or materials from network members and is designed to automatically accept or reject bid requests, depending on the nature of the bid requests and also depending on the availability of time in a network member's schedule. Advantageously, since schedules are maintained by the Distributed Scheduling Subsystem **28**, a network member does not have to be in continuous communication with the computer network system **10**. A network member can, instead, periodically dial-in and connect to the Network Service Distribution System **20** using a personal computer and modem, including a small portable computer with a cellular modem.

The Integrated Work Activity Calendar Subsystem **64** may serve as a means for obtaining fabrication schedules and supplier schedules from the Distributed Scheduling Subsystem **28**. If changes are made to a schedule, the Distributed Scheduling Subsystem **28** may serve as a means for obtaining the change and for automatically modifying a restrictive link associated with the change. If the restrictive link may not be modified because of schedule conflicts or for other reasons, an error message is returned. A network member has the option of canceling a contract with another network member, which deletes any restrictive links associated with the contract and sends a message to the affected network members, via the General Transaction Services Subsystem **32**, indicating that a contract has been canceled. When an Integrated Project Management Subsystem **66** receives such a message it attempts to automatically handle the scheduling conflict. It issues bid requests to try and reestablish the contract with the same network member at a different time. If this fails within the preceding float range allowed for the conflicted work stage, the Integrated Project Management Subsystem **66** then issues bid requests to other network members. Unresolved scheduling conflicts preferably generate notifications to affected network members.

Schedule Synchronization Between Network Members

Typically each member of the computer network system **10** is a separate business entity within an industry and has one or more work schedules. Generally, there are two types of work schedules: CPM schedules, and work activity calendar schedules. A work activity calendar schedule is simply a schedule of appointments. It is similar like the notebook of scheduled activities that a businessman maintains. A CPM schedule is a sequential arrangement of work stages, some of which may not begin until previous ones have been completed. Individual tasks can be work stages in both types of schedules. Restrictive links can be established between either of these two types of schedules. Work stages within a schedule may have restrictions placed on them by their owners to indicate how far the starting and ending times of the work stage can vary.

A work stage is a step in the fabrication of a product and has a time duration defined by a starting time and an ending time. As used herein, the terms "time(s)" and "date(s)" shall have the same meaning and shall be interchangeable. Schedules can be at different scales, with more detailed schedules inside of lesser detailed schedules. For example: a schedule of new office construction in a business park—office one must be completed before office two can begin, and so forth. Each office project can have a detailed schedule of events required to complete its construction. Thus, the detailed schedule is a "child" of the lesser detailed "parent." Preferably, work stages cannot be linked to work stages shared between parent and child projects. For example, if work stage A is part of a project which is contained in work stage B, then no work stage that is in the same project as work stage B may be linked to work stage A, as this would cause a circular dependency. With this restriction in place, the system can allow for entire projects within a single work stage.

In the illustrated embodiment, the Distributed Scheduling Subsystem **26** automatically updates interrelated schedules of network members and allows each network member to make changes to its schedules in consideration of up-to-date knowledge about the status of the schedules of other network members. Preferably, the Distributed Scheduling Subsystem **26** utilizes enhanced CPM scheduling techniques which permit restrictions and relationships to be established between a broad range of work stages and project scales, each able to be restricted by the other, regardless of the scale of a stage of work. For example, a set of work stages that define a project can be considered as a single work stage that is related to or restricted by, one or more other work stages, jobs, large-scale projects, and the like. Similarly, a collection of jobs that make up a large scale project may be considered a single work stage that is related to or restricted by a work stage, a job, a large-scale project, and the like. Preferably, the Distributed Scheduling Subsystem **28** stores the various fabrication and supplier schedules of network members within one or more databases.

Referring now to FIG. **4**, a method of synchronizing a fabrication schedule and a plurality of supplier schedules, according to the present invention, is illustrated. Steps include: obtaining a fabrication schedule from a fabricator data processing system (Block **100**); obtaining supplier schedules from respective supplier data processing systems (Block **102**); establishing restrictive links among a fabrication schedule and supplier schedules (Block **104**); obtaining a change in a fabrication schedule work stage (Block **106**); automatically modifying restrictive links in response to an obtained change (Block **108**); and communicating a modified fabrication or supplier schedule to a fabricator data processing system or to a supplier data processing system (Block **110**).

The illustrated method is preferably recursive such that it calls itself for the purpose of determining whether changes are necessary to other schedules of network members when a given schedule has a changed time. When the starting time of a restrictively linked work stage is changed, and nothing prevents the work stage on the other end of the restrictive link from changing its starting or ending time, the Distributed Scheduling Subsystem **28** automatically modifies the restrictive link in response to the starting time change. In the illustrated embodiment, the Distributed Scheduling Subsystem **28** handles the process of checking whether work stages restrictively linked can be rescheduled. Each restrictive link contains information about the range of time within which a work stage starting or ending time can be changed. If a work stage cannot be automatically rescheduled, the changes are not made and a conflict error is returned to network members affected by the conflict.

If scheduling conflicts cannot be resolved by rescheduling, the present invention is designed to attempt to reschedule with another network member from a predetermined list of alternates. For example, if a home builder's fabrication schedule has a work stage for framing with a starting time that has slipped such that a restrictively linked framing crew A cannot perform the work, the present invention will attempt to establish a contract between the home builder and another framing crew on that home builder's list of approved framing crews. The present invention may attempt to resolve scheduling conflicts by delaying the starting times of restrictively linked schedules. If this is unsuccessful, alternative resolutions may be pursued.

FIGS. **5A**, **5B**, **5C** are flow diagrams, illustrating a recursive method of synchronizing a fabrication schedule and a plurality of supplier schedules, according to one embodiment of the present invention, when a change is made to the fabrication schedule. To make modifications to an existing fabrication schedule, a network member (fabricator) "checks out" or obtains a copy of the fabrication schedule from the Distributed Scheduling Subsystem **28**, makes the changes to the fabrication schedule, and attempts to synchronize the modified fabrication schedule with other supplier schedules. Referring now to FIG. **5A**, for each fabrication schedule stored (or to be stored) within the Distributed Scheduling Subsystem **28**, a CPM calculation method is performed to generate starting and ending dates of all work stages within the fabrication schedule (Block **122**). This may be performed either locally via a Calendar-Driven Desktop System **60**, or centrally via a Network Service Distribution System **20**. For existing fabrication schedules that are being checked into the Distributed Scheduling Subsystem **28**, a copy of the fabrication schedule, as it existed when it was checked out from the Distributed Scheduling Subsystem, is obtained (Block **124**).

When a modified or new fabrication schedule is checked-in with the Distributed Scheduling Subsystem **28**, the pre-existing starting and ending times of all work stages are compared with those of the fabrication schedule to identify any changes. This is illustrated as an iterative loop (Block **126**–Block **130**) in FIG. **5A**. If any work stage starting times are changed, several steps are then performed. First, a work stage having a changed starting or ending time is checked to see if a lower level fabrication schedule is contained within the work stage with the changed starting or ending times (Block **132**). If there is a lower level fabrication schedule

associated with a work stage having changed starting or ending times, then the lower-level fabrication schedule is recursively checked-out (Block **134**). If the overall starting time (i.e., the starting time of the first work stage in the schedule) of the lower-level fabrication schedule has been changed, a CPM calculation is performed to generate new starting and ending times for each work stage (Block **136**) within the lower-level fabrication schedule. The lower-level fabrication schedule is then recursively checked back in (Block **138**). The recursive check-in allows for a continuous comparison of work stage starting times with original starting times. Next, a determination is made whether the lower-level fabrication schedule has been successfully checked in without any errors (Block **140**). If the answer is yes, the procedure proceeds to Block **142**, otherwise, the procedure proceeds to Block **164**.

Referring now to FIG. **5B**, after lower-level fabrication schedules have been modified and recursively checked, where necessary, a fabrication schedule work stage having a changed starting or ending time is checked for a restrictive link with a supplier schedule (Block **142**). If no restrictive link exists for the changed work stage, the procedure continues in an iterative loop to the next work stage having a changed starting or ending time and checks for any restrictive links thereto (Block **144**). If no restrictive links are found for any work stages having changed starting or ending times, the procedure terminates, and the fabrication schedule is checked in. When no restrictive links exist between work stages of a fabrication schedule that have been changed and supplier schedules, any changes made to the fabrication schedule have no impact on the supplier schedules.

If a fabrication schedule work stage with a changed starting or ending date is restrictively linked to a supplier schedule, this supplier schedule is located (Block **146**). A determination is made whether the restrictively linked supplier schedule can be changed in accordance with the change to the work stage at the other end of the restrictive link (Block **148**). If the supplier schedule can be rescheduled, the supplier schedule is checked-out by the Distributed Scheduling Subsystem **28** (Block **152**), and the supplier schedule is changed accordingly (Block **154**). If the supplier schedule contains work stages sequentially arranged, a CPM calculation is performed to generate starting and ending times (Block **156**). The supplier schedule is then recursively checked-in with the Distributed Scheduling Subsystem **28** (Block **158**). If check-in is successful (Block **160**), the recursive procedure continues to the next fabrication schedule work stage with a changed starting or ending time (Block **162**) and the above-described procedure is repeated. If check-in is not successful, the procedure proceeds to Block **164**.

During the recursive procedure described above, if any schedule changes are not allowed, a conflict error message is returned to the appropriate subsystem within the affected network member's Calendar-Driven Desktop System **60** and no schedule changes are made. Database updates for schedule check-ins are delayed until the recursive procedure is complete. When the procedure is complete, all stored schedules are updated. If an unsuccessful check-in of a supplier schedule has occurred (Block **160**) or if a restrictive link does not allow a supplier schedule to change (Block **148**), the supplier schedule is marked within a temporary table as checked-in (Block **164**) and an error message is returned (Block **166**).

Referring now to FIG. **5C**, when the iterative loop defined by Block **126**–Block **130** is complete, the fabrication schedule is stored within a temporary table (Block **168**). A determination is made whether this is the first recursive call to check-in (Block **170**). If the answer is yes, the temporary table is stored within the fabrication schedule database and all schedules are indicated as checked-in (Block **172**). If the answer is no, a message of successful check-in is returned (Block **174**).

The above-described recursive procedure is applicable to all schedules, including fabrication and supplier, that are changed and which are restrictively linked with other schedules. The present invention preferably includes additional features such as when a threshold amount of computer storage space is exceeded by changed schedules. If such a threshold is exceeded, an error message is produced. Additionally, if an attempt is made to check-out a schedule that is already waiting to be updated by the same recursive procedure, an error message is returned. If an attempt is made to check-out a schedule that is waiting to be updated by another recursive procedure, the system waits until that recursive procedure is completed.

It will be understood by those having skill in the art that one or more of the steps set forth in the flow charts of FIGS. **4** and **5A**, **5B**, **5C** may be implemented using computer readable program code, embodied within computer usable media, executing on a general purpose computing system, on a special purpose computing system, or on a combination thereof. It will also be understood that, for the flow charts set forth in FIGS. **4** and **5A**, **5B**, **5C**, each block, and combinations thereof, may be implemented by computer program instructions. These computer program instructions may be loaded into a computer or other programmable apparatus to produce a machine, such that the instructions which execute on the computer or other programmable apparatus create means for implementing the functions specified in the flow chart block or blocks.

The computer program instructions may also be stored in computer readable media (including magnetic media, optical media, read only memory, random access memory, and the like) that can direct a computer or other programmable apparatus to function in a particular manner, such that the instructions stored in the computer readable media produce an article of manufacture including instruction means which implement the function specified in a flow chart block or blocks. The computer program instructions may also be loaded into a computer or other programmable apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions specified in a flow chart block or blocks.

According to another aspect of the illustrated embodiment in FIG. **1**, the Integrated Project Management Subsystem **66** may be constantly updated with work progress by network members. The term "work progress" includes expected work stage completion times and actual work stage completion times. When work progress shows that a work stage ending time is expected to be delayed, the Integrated Project Management Subsystem **66** may check-out the fabrication schedule, update work stage starting and/or ending times accordingly, and perform a CPM calculation to generate starting and ending times for all work stages in the fabrication schedule. The Integrated Project Management Subsystem **66** may then attempt to check-in the fabrication schedule into the Distributed Scheduling Subsystem **28**. Depending on the existence of restrictive links, this operation may succeed or fail. If it fails, the Integrated Project Management Subsystem **66** may receive a list of conflicting

restrictive links from the Distributed Scheduling Subsystem **28** which are used to develop solutions to the scheduling conflict(s). Depending on the nature of a particular project or work stage, the Integrated Project Management Subsystem **66** may cancel the originally scheduled process or relationship with a supplier and establish a new one with another network member supplier. The Integrated Project Management Subsystem **66** may also force a delay on a work stage starting time, re-compute the fabrication schedule, and attempt to check-in the fabrication schedule with the Distributed Scheduling Subsystem **28**. According to one aspect of the present invention, the Integrated Project Manager Subsystem **66** may be designed to automatically track fabrication and supplier schedules of network members and keep them synchronized or find solutions when scheduling conflicts arise.

Home Building Industry Example 1

In the home building industry, a home builder typically has several projects (houses) under construction and others that are about to start. Each project has a fabrication schedule with multiple, sequentially arranged work stages stored in a Distributed Scheduling Subsystem **28**. As the home builder enters into contracts for materials and labor for each work stage, restrictive links are established among the fabrication schedule and the multiple supplier schedules. The process of forming contracts with other network member suppliers is preferably performed via the General Transaction Services Subsystem **32**. When a contract is formed between the home builder and a supplier, the Integrated Project Management Subsystem **66** "checks-out" the home builder's fabrication schedule for this project. Preferably, at about the same time, the Integrated Work Activity Calendar **64** for the home builder checks-out the activity calendar for the subcontractor/supplier. Both systems (the Integrated Project Management Subsystem **66** and Integrated Work Activity Calendar **64**) indicate that a restrictive link has been established between at least one work stage in the fabrication schedule and a supplier schedule, per the established contract. Both systems (the Integrated Project Management Subsystem **66** and Integrated Work Activity Calendar **64**) check-in the restrictively linked fabrication and supplier schedules. Preferably, the Distributed Scheduling Subsystem **28** recognizes restrictive link indicators and establishes actual restrictive links between the respective schedules.

Preferably, work progress is recorded into the Integrated Project Management Subsystem **66** which calculates the starting and ending times of the fabrication schedule work stages using CPM calculation methods. The fabrication schedule is checked-in and a changed starting time for a work stage is identified. The home builder's Work Activity Calendar is contacted to see if the time change can be accommodated. If yes, the starting time change is made. If no, the check-in fails and an error message is returned to the Integrated Project Management Subsystem **66** of the home builder.

Assigning Float Time to Work Stages Within a Critical Path Schedule

A critical path schedule includes a sequential arrangement of work stages, some of which cannot be performed until a prior one is performed. If a starting time is known for a given schedule, the starting and ending times for each work stage in the schedule can be computed utilizing various CPM calculation methods known to those having skill in the art. A delay to one work stage in a critical path will have a cascade effect on the schedule such that for each day a work stage is delayed, a delay to the entire schedule results. Work stages that are not on the critical path are considered to have float. A work stage with three days float can exceed its scheduled duration by three days without affecting the overall schedule.

Referring now to FIGS. 2A,2B,2C, four different projects **70***a*, **70***b*, **70***c*, **70***d*, each with three work stages slated to last one day, are illustrated. Alone, each project should take three days to complete; however, some of the work stages must await the completion of work stages in other projects. With such an interdependency of work stages, a single change to a work stage can cause a large sequence of cascade schedule changes. FIG. 2B clarifies the actual flow of completion for each project illustrated in FIG. 2A. Projects **1**, **3** and **4** can begin on day one, but Project **2** is delayed by a day until the completion of work stage **1** in Project **1**. Though Project **3** can start on day one, it has a two day delay before work can continue as it awaits the completion of work stage **2** for Project **2**, and so forth. Though requiring the same number of days to complete, and even though it began at the same time as Project **1**, Project **4** requires three extra days to complete because of work stage **3** of Project **3**.

FIG. 2C illustrates the cascade effect caused to the four projects in FIGS. **2A** and **2B** when a single work stage in one of the projects is delayed. Because work stage **3** in Projects **1** and **2**, and work stage **2** in Project **3** are all dependent upon the completion of work stage **2** in Project **2**, they are each delayed until work stage **2** in Project **2** is completed.

According to another aspect of the present invention, the Distributed Scheduling Subsystem **28** prevents small schedule changes to critical path schedules from causing large cascading schedule changes. This is accomplished by adding a quantity of time, referred to as "float time", to the starting time of a selected work stage or activity, as illustrated in FIGS. 3A and 3B. FIG. 3A illustrates multiple work stages **84–90** which define a critical path. Work stages **85**, **88** include preceding float time **85***a*, **88***a*, respectively, prior to their starting time. As a result of the preceding float time, work stages **85**, **88** are not on the critical path that determines the minimum length of the schedule. Note that there is a two day difference between the start of work stage **88** with preceding float **88***a* and work stage **87**.

FIG. 3B depicts the effects on the schedule illustrated in FIG. **3A** as a result of a one day delay to the first work stage **84**. Consistent with CPM scheduling techniques, each work stage on the critical path is delayed by one day, causing the entire schedule to take one day longer than originally planned. However, the actual work days scheduled for work stage **85** remained the same and the available preceding float **85***a* has simply been reduced. The entire cascade potential on the subsequent work stage with preceding float time has thus been absorbed. As a result, the preceding float time remains unchanged for work stage **88** even though other work stages around it, have been adjusted. Note the two day gap between work stages **87** and preceding float **88***a* (FIG. **3A**) has been reduced to only 1 day. Utilizing the preceding float allowed the fabricator's system to manage the start times after the delay so that the system did not automatically bump the succeeding work stage back an additional day. Rather, the system utilized the pre-determined preceding float in order to hold the later work stages to their original start dates, therefore not all work stages were changed, thus not all suppliers were affected.

According to the present invention, if a work stage in the critical path has an ending time later than scheduled, pre-

ceding float time on following work stages can prevent them from being rescheduled. When a work stage starting or ending time is modified, the preceding float time is adjusted in order to keep the actual work stage starting time the same. Preferably, the preceding float quantity is restricted such that it cannot go below zero or above a maximum preceding float quantity.

Automatic Product Information Undating

Typically, product distributors purchase products from product manufacturers and sell them to retailers and end users. When product manufacturers make changes to their products, or change information about their products, distributors typically accumulate this information and retransmit it (in printed or electronic form) to retailers and end users. The task of collecting and re-transmitting product information can be daunting. The present invention, through the Network Service Distribution System **20**, makes product manufacturer information available to all network members who need the information without the duplicative efforts of distributors. The present invention allows product information to flow directly from manufacturers to retailers, distributors, and end users without interfering with the established channels of trade and business relationships.

The present invention, via the Distributed Product Data Management Subsystem **34**, facilitates the electronic distribution of product information from network members who are product manufacturers to other network members. Because network members can view product information electronically and because the information is updated by manufacturers and automatically distributed down through the network, network members who are distributors do not have to maintain and redistribute constantly changing manufacturer product information.

According to one aspect of the present invention, a computer based product catalog system is provided. The computer based product catalog system includes multiple electronically stored manufacturer catalogs which include descriptive text, numerical data (measurements), multimedia information (video, audio, etc.) describing items manufactured by respective manufacturers, and based on standardized data models for different product types. An electronically stored distributor catalog including links to manufacturer product information, modifications to the descriptions of selected items from the various manufacturers, and distributor specific data regarding availability, deliver schedules, and the like. Also included within the system is a subsystem for automatically updating the descriptions of items within the manufacturer catalogs, and a subsystem, responsive to the automatic updating subsystem, for maintaining the links to items within the distributor catalog. A terminal, operatively connected to the manufacturer catalogs and to the distributor catalog, may be provided for viewing item descriptions within the manufacturer and distributor catalogs at the retail level of product distribution. A subsystem may be provided within the terminal for ordering items from the manufacturer and distributor catalogs.

According to an embodiment of the present invention, each manufacturer may access the Distributed Product Data Management Subsystem **34** to enter and maintain product information, including images, specifications, descriptions, and wholesale and/or retail pricing information. Each distributor may access the Distributed Product Data Management Subsystem **34** to select and maintain the list of products they will provide from any number of different manufacturers. Retailers, end users, and the like, can view the products offered by all network member distributors, including the manufacturer's product information, without concern that the information is outdated or inaccurate. The present invention facilitates the organization and presentation of product information in numerous formats. For example, all products of a given type, all products by manufacturer, may be grouped and viewed together. Network members may also view product information directly from a given manufacturer.

Referring now to FIG. **6**, the distribution of product information, according to one aspect of the present invention, is schematically illustrated. A variety of unique on-line product catalogs are shown being generated and updated without the need for distributors to reorganize and retransmit them as manufacturer specifications change. As shown, all products originate from manufacturers, (whether a single artisan fabricating unique works of art, or a major company creating thousands of reproductions of a single product). In all cases, a digital catalog record of textual descriptions, specifications, drawings, photographs, video clips, animation, price information, and any other desired information, is created for each product and made available to network members via the Network Service Distribution System **20**.

In the illustrated embodiment shown in FIG. **6**, Manufacturer **1** maintains an electronically stored catalog **200** of products for sale directly to distributors, retailers, and end users, each of whom is a network member. Each is allowed to view all or portions of Manufacturer **1**'s catalog **200**, according to Manufacturer **1**'s discretion. End user **1** (**208**) may view the catalog **200** of Manufacturer **1** and may view the regional catalog **204** of Distributor 1 as indicated by single-arrowhead connectors **232**. End User **1** (**208**) may purchase products from Retailer 1 (**206**) or from Manufacturer **1**, as indicated by double-arrowhead connectors **234**. Distributor **1** maintains a catalog **202** of products purchased from Manufacturers **1**, **2**, and **3** via their respective catalogs **200**, **210**, and **212**, as indicated by double-arrowhead connectors **234**.

Distributor 1 markets and distributes selected products from the catalogs of Manufacturers **1**, **2**, and **3** (**200**, **210**, **212**). The result is a unique catalog having a variety of products. Should any manufacturer update its product information via the Network Service Distribution System **20**, it is automatically updated within Distributor **1**'s general catalog **202** and regional catalog **204**. Because Distributor **1** allows Retailer 1 (**206**) and the End User 1 (**208**) to view its regional catalog **204**, the updated product information from Manufacturer **1** is available without Distributor 1 having to reformat or retransmit the product information.

Still referring to FIG. **6**, Manufacturer **2** supplies products to Distributor 1 and 2. Distributor **1** and **2** include information about these products within their respective catalogs **202**, **214**. This results in unique catalogs of products available to Retailer **1** (**208**) and Retailer **2** (**218**). In the illustrated embodiment, Retailer 1 (**208**) may view Manufacturer **2**'s catalog **210**, as indicated by single-arrowhead connector **232**, even though purchasing of products is only available through Distributor **1**. Retailer **2** (**218**) may view Manufacturer **2**'s catalog **210**, but can purchase only from Distributor **2** via Distributor **2**'s regional catalog **216**. Manufacturer **3** is different from Manufacturer **2** in that only Distributors **1** and **2** may view or purchase products from its catalog **212**, as indicated by double-arrowhead connectors **234**. In the illustrated embodiment, a Specialized Provider has a unique catalog **220** of products purchased from Retailer **1** and **2**

(206, 218) as indicated by double-arrowhead connectors 236. End User 1 (208) may view and purchase products from the Specialized Provider catalog 220 as indicated by double-arrowhead connector 238.

As illustrated in FIG. 6, the present invention facilitates the creation and automatic maintenance of many electronically stored product catalogs. In the illustrated embodiment, thirteen different catalog configurations containing products created by 3 different manufacturers are available to network members. Rather than thirteen different catalogs requiring reprinting or updating every time a manufacturer makes a change to specifications or product information, the present invention provides real-time updates as soon as they are made by a manufacturer.

Both the Network Service Distribution System 20 and each Calendar-Driven Desktop System 60, according to the present invention, may be implemented via a variety of computing devices, including, but not limited to, mainframe computing systems, mini-computers, and personal computers. It will be understood that a computer or other apparatus configured to execute the program code, embodied within computer usable media, operates as means for performing the various functions and carries out the methods of the various operations, according to the present invention. Stored computer. readable program code also acts as a means for carrying out the various methods and functions of the present invention.

Computer readable program code means is provided for retrieving a copy of a first schedule from the network service distribution system, for changing at least one work stage starting or ending time in the copy of the first schedule, and for automatically changing the starting and ending times of work stages in the stored first schedule and a second stored schedule restrictively linked to the first schedule as a result of changes made to the copy of the first schedule. In particular, computer readable program code means is provided for each of the following: comparing a copy of a first schedule with the first schedule stored within the network service distribution system to identify changed work stage starting and ending times; identifying whether a restrictive link exists between a work stage of a first schedule and a work stage of a second schedule; determining whether the identified restrictive link permits the starting or ending times of the second schedule to be changed; and automatically changing the starting and ending times of the second schedule work stage, thereby synchronizing the first and second stored schedules.

The present invention may be written in various computer languages including, but not limited to, C++, Smalltalk, Java, and other conventional programming languages such as BASIC, FORTRAN and COBOL. The Network Service Distribution System 20 and the Calendar-Driven Desktop System 60 preferably run on current standard desktop computer operating systems such as, but not limited to, Windows®, Windows 95®, Windows NT®, UNIX®, and OS/2®. The present invention utilizes, in part, many standard features of current desktop configurations, such as the ability to store data locally, connect to the Internet, and display visual information.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

What is claimed is:

1. A computer based product catalog system for distributing product information in real time to separate business entities within the building industry, comprising:

a communications network;

a first data processing system of a first product manufacturer within the building industry in communication with the communications network, wherein the first data processing system comprises:

a first product catalog that includes descriptions of first products which are manufactured by the first product manufacturer within the building industry; and

first means for updating the descriptions of the first products in the first product catalog;

a second data processing system of a second product manufacturer within the building industry in communication with the communications network, wherein the second data processing system comprises:

a second product catalog that includes descriptions of second products which are manufactured by the second product manufacturer within the building industry; and

second means for updating the descriptions of the second products in the second product catalog;

a third data processing system of a product distributor within the building industry in communication with the communications network, wherein the third data processing system comprises a third product catalog that includes selected ones of the descriptions of the first products and the second products;

a retail terminal of a product retailer within the building industry in communication with the communications network, wherein the retail terminal comprises means for displaying product descriptions in the first, second, and third product catalogs; and

third means, responsive to the first and second means, for automatically updating in real time the selected ones of the descriptions of the first and second products in the third product catalog.

2. A computer based product catalog system according to claim 1 wherein the retail terminal further comprises ordering means, for ordering items from the first, second, and third product catalogs, via the retail terminal.

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Wiecha

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[54] **SYSTEM FOR ORDERING ITEMS OVER COMPUTER NETWORK USING AN ELECTRONIC CATALOG**

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[51] **Int. Cl.**[6] **G06F 153/00**

[52] **U.S. Cl.** **705/26**; 235/385

[58] **Field of Search** 395/201, 226–228, 395/244; 379/91.01; 340/825.26–825.28, 825.33–825.35; 283/56; 235/378–381, 385; 902/22, 30–33; 705/1, 26–28; 707/1, 10, 200

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,992,940	2/1991	Dworkin	235/383
5,315,504	5/1994	Lemble	395/650
5,319,542	6/1994	King, Jr. et al.	235/383
5,570,291	10/1996	Dudle et al.	364/188
5,576,951	11/1996	Lockwood	395/227

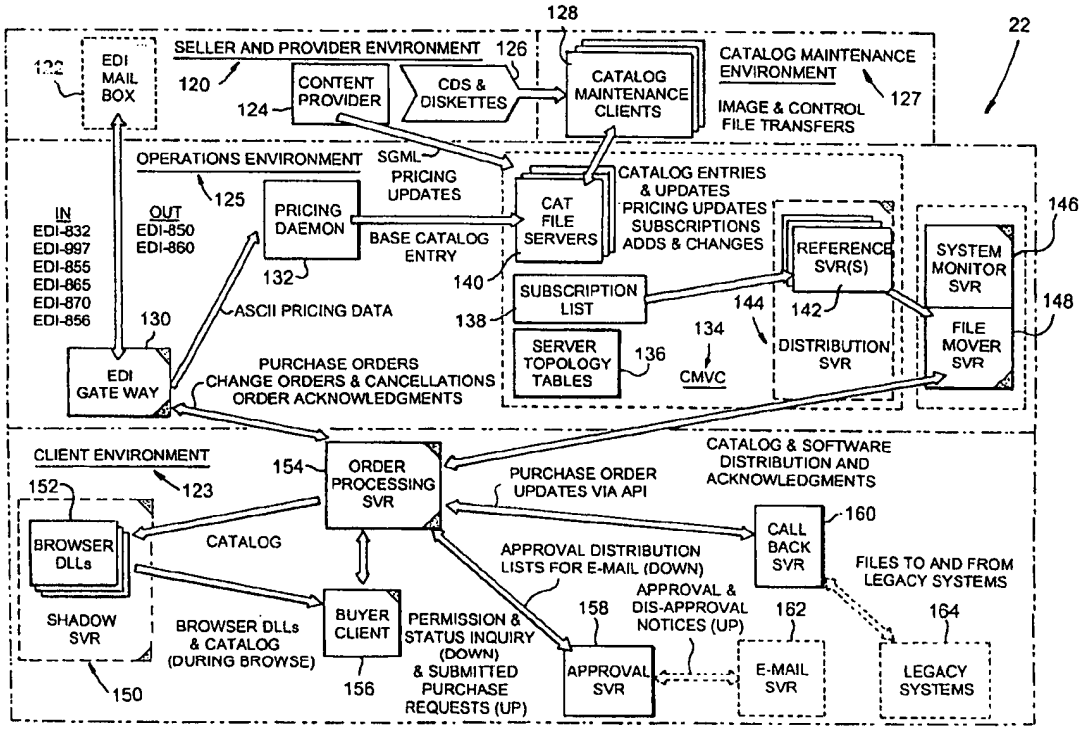
Primary Examiner—Frantzy Poinvil

Attorney, Agent, or Firm—Stephen C. Kaufman, Esq. IBM Corporation; Scully, Scott, Murphy & Presser

[57] **ABSTRACT**

Current corporate purchasing procedures are labor-intensive and therefore costly. The system enables an employee who needs an item which must be ordered from a supplier to select the item from an electronic catalog displayed on a personal computer and submit an order for approval and processing directly, by-passing both the normal paper approvals and the manual verification of the order by the organization's Purchasing department. It achieves this by means of an electronic catalog accessible from the employee's own personal computer, and a computer network and associated services linking the enterprise to one or more suppliers.

6 Claims, 12 Drawing Sheets



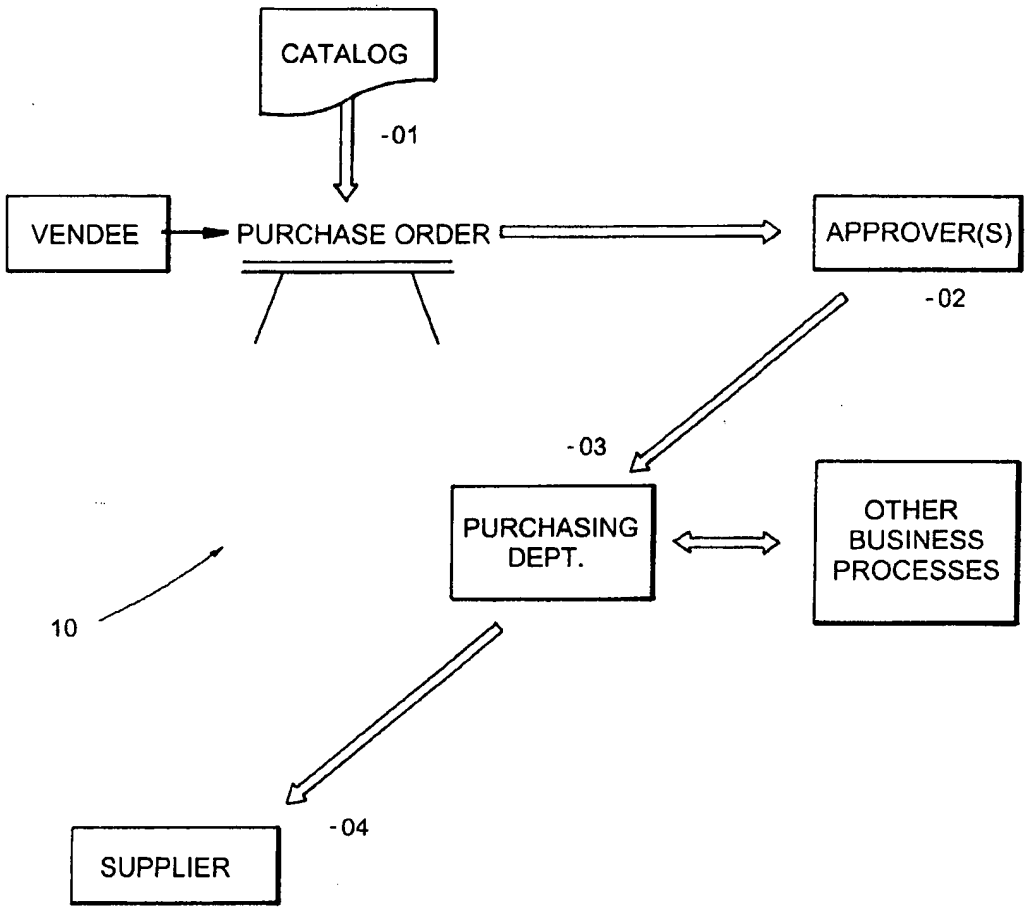


Fig. 1
(Prior Art)

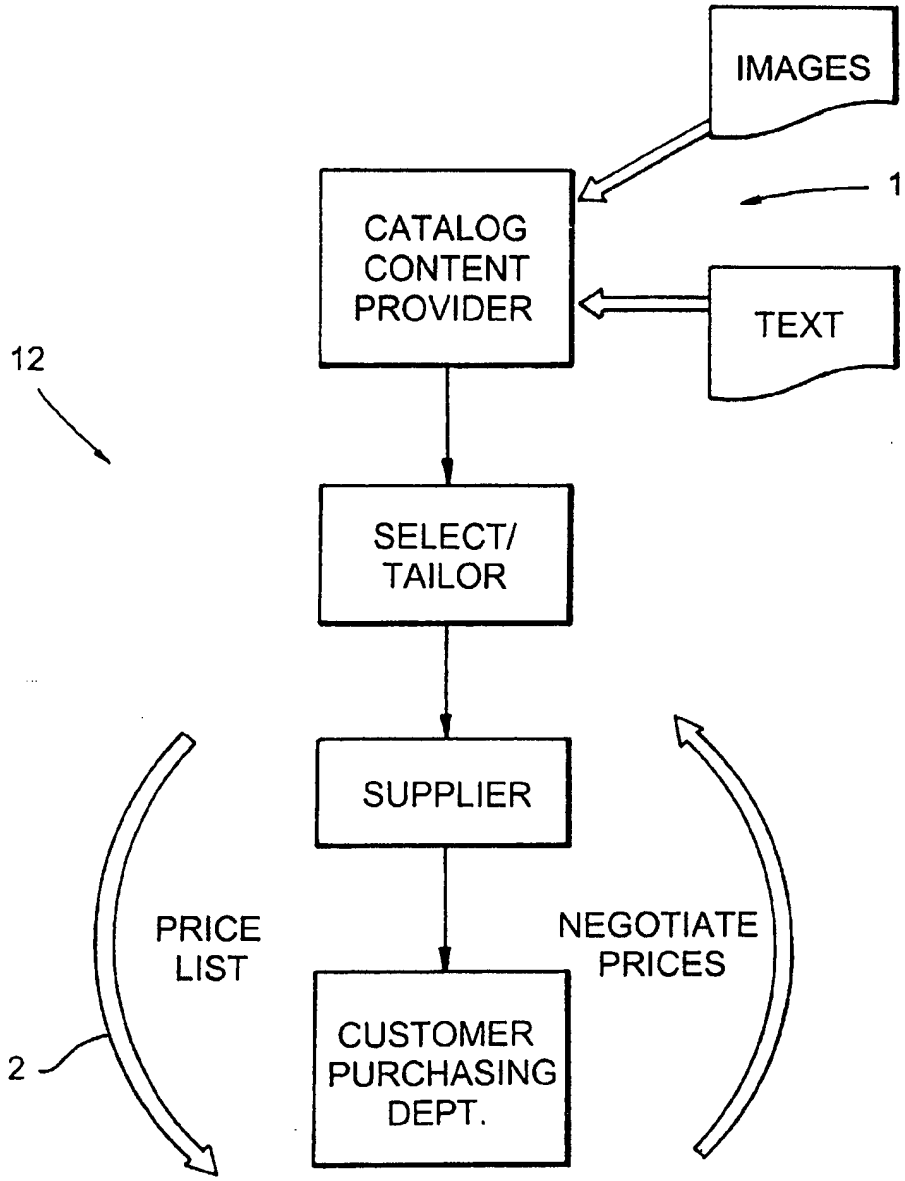


Fig. 2
(Prior Art)

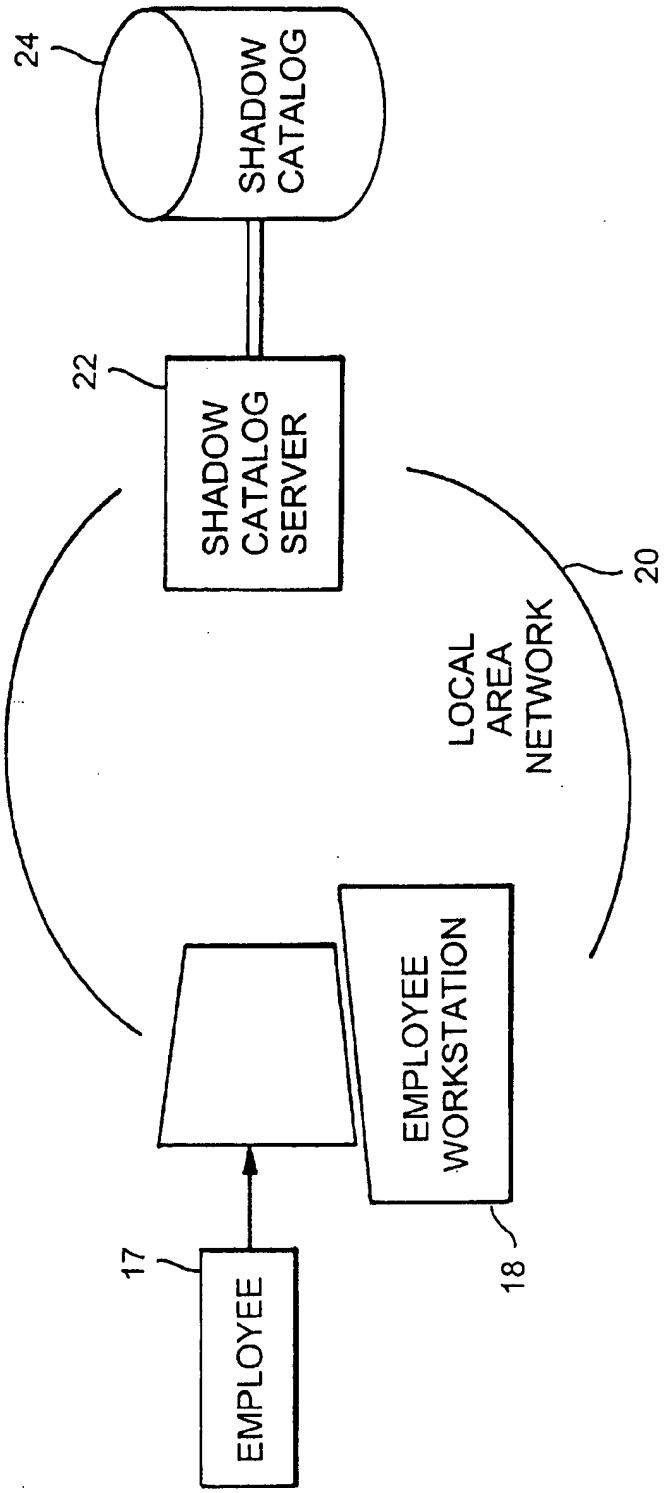

24
SHADOW CATALOG
22
SHADOW CATALOG SERVER
20
LOCAL AREA NETWORK
EMPLOYEE WORKSTATION
18
14
17
EMPLOYEE

Fig. 3

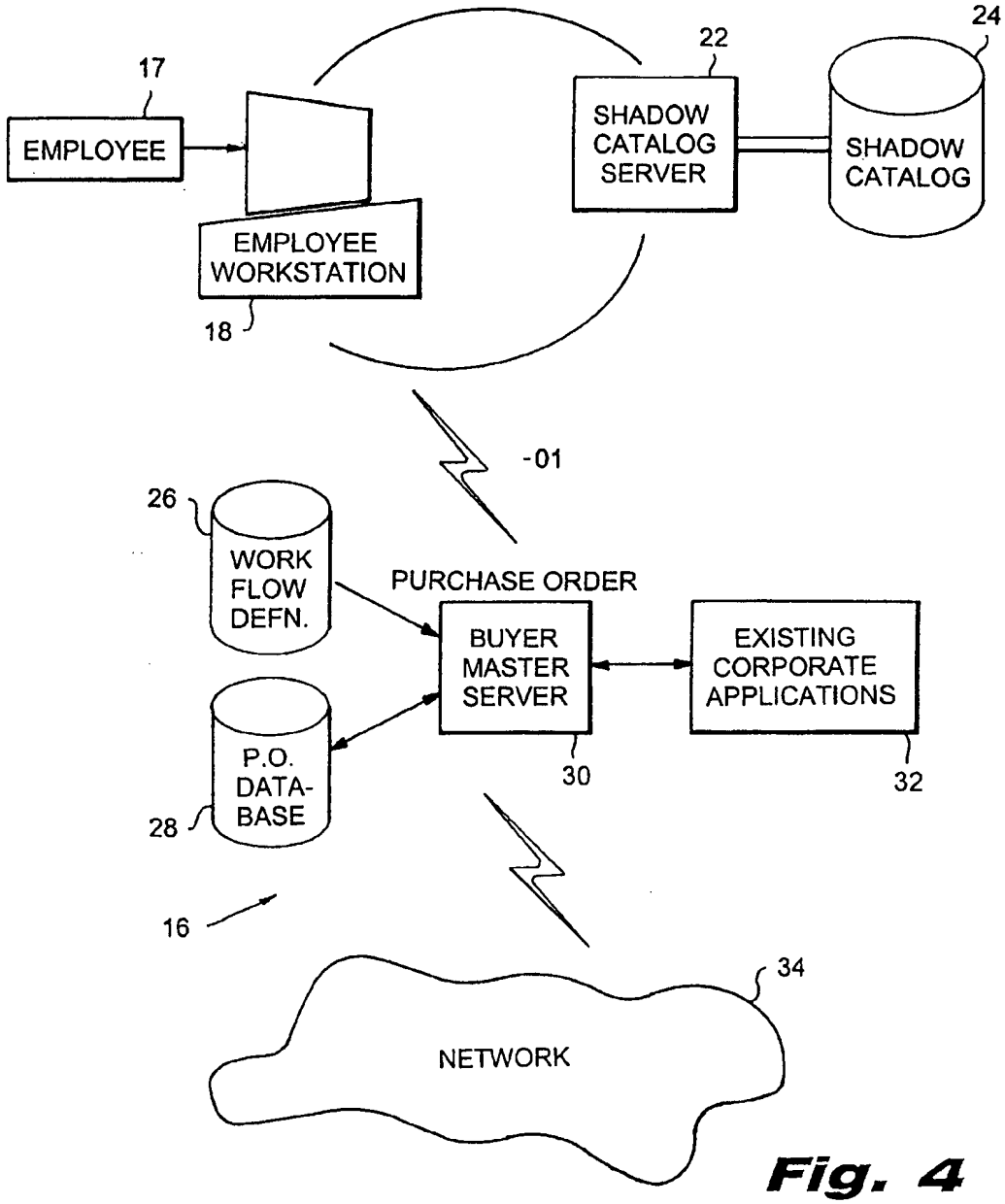

17
EMPLOYEE
EMPLOYEE WORKSTATION
18
22
SHADOW CATALOG SERVER
24
SHADOW CATALOG
-01
26
WORK FLOW DEFN.
PURCHASE ORDER
BUYER MASTER SERVER
30
EXISTING CORPORATE APPLICATIONS
32
P.O. DATA-BASE
28
16
34
NETWORK

Fig. 4

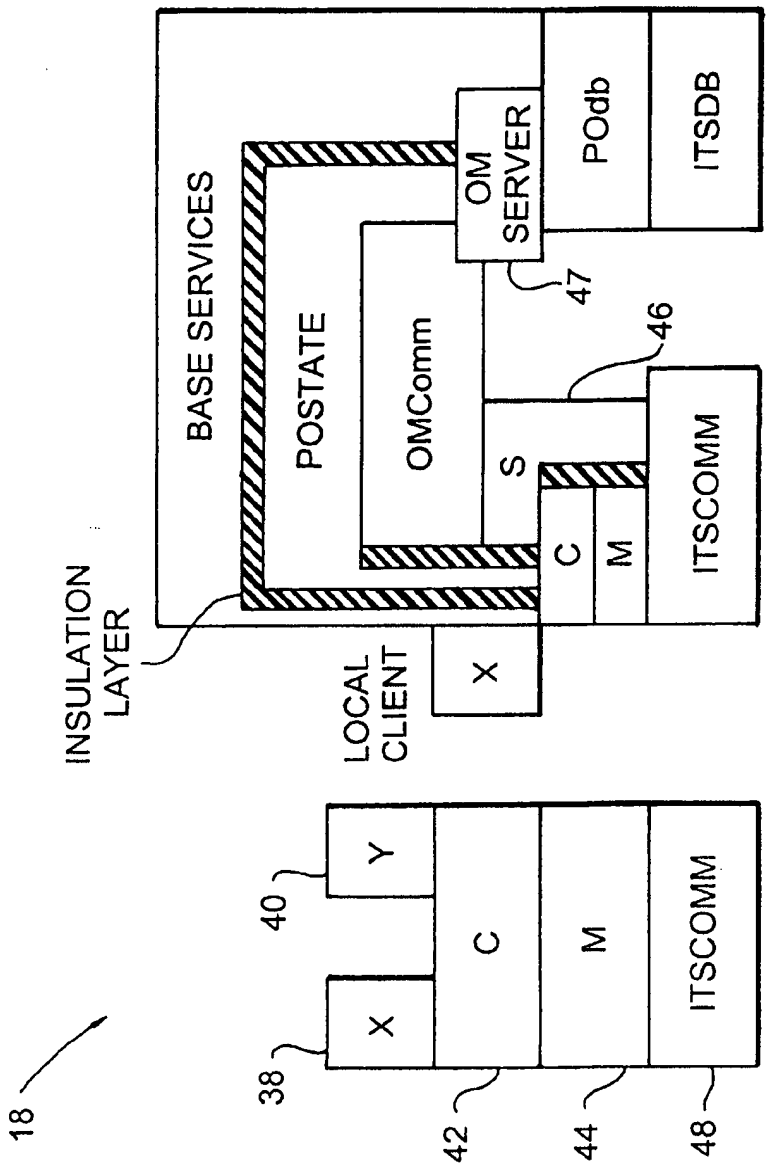

18
38
X
40
Y
42
C
44
M
48
ITSCOMM
INSULATION LAYER
LOCAL CLIENT
X
BASE SERVICES
POSTATE
OMComm
OM SERVER
47
POdb
ITSDB
46
S
C
M
ITSCOMM

Fig. 5

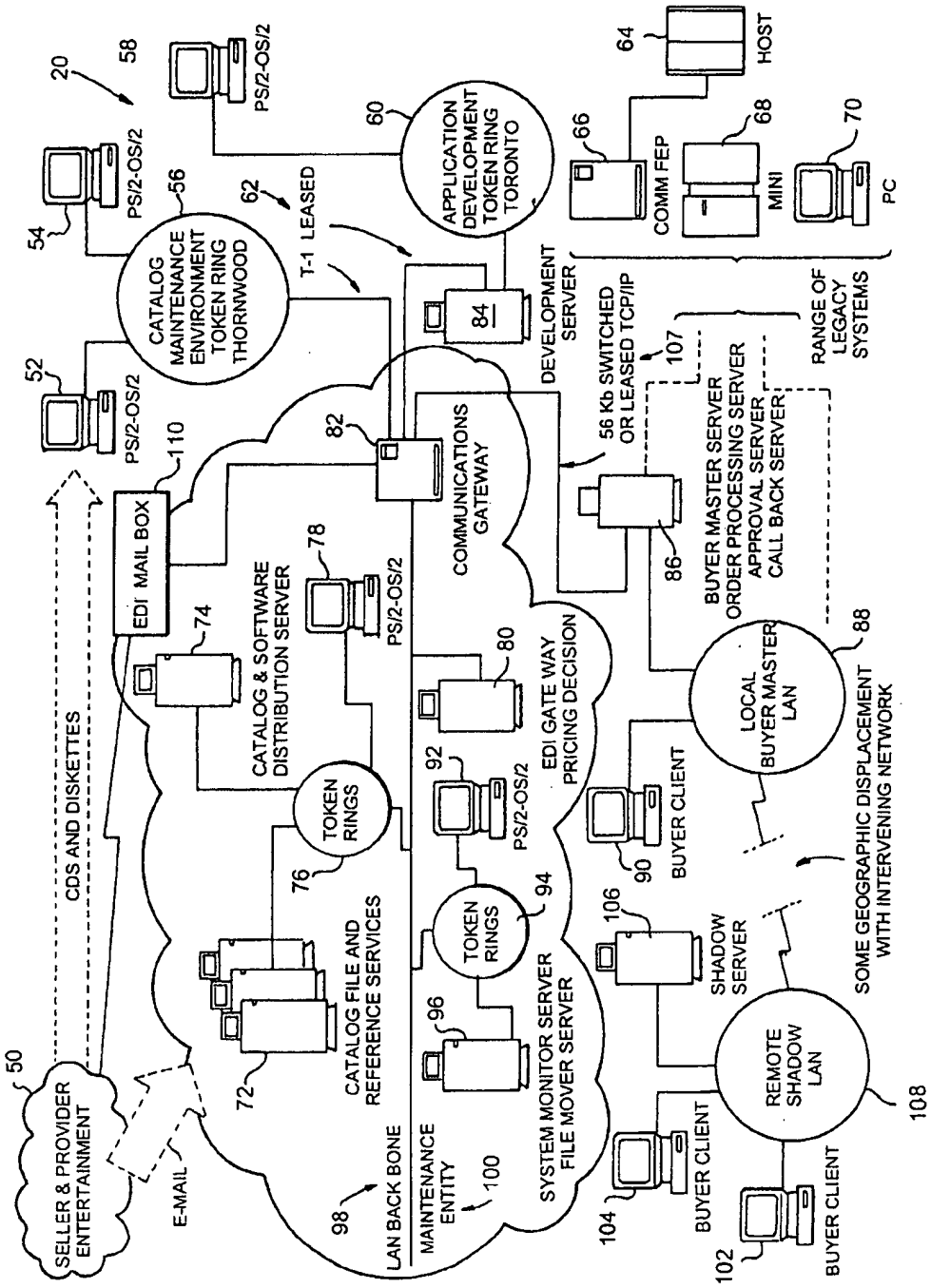

SELLER & PROVIDER ENTERTAINMENT
CDS AND DISKETTES
E-MAIL
LAN BACK BONE
MAINTENANCE ENTITY
CATALOG MAINTENANCE ENVIRONMENT TOKEN RING THORNWOOD
T-1 LEASED
APPLICATION DEVELOPMENT TOKEN RING TORONTO
DEVELOPMENT SERVER
COMMUNICATIONS GATEWAY
56 Kb SWITCHED OR LEASED TCP/IP
EDI MAIL BOX
CATALOG & SOFTWARE DISTRIBUTION SERVER
CATALOG FILE AND REFERENCE SERVICES
TOKEN RINGS
SYSTEM MONITOR SERVER FILE MOVER SERVER
EDI GATE WAY PRICING DECISION
BUYER MASTER SERVER ORDER PROCESSING SERVER APPROVAL SERVER CALL BACK SERVER
RANGE OF LEGACY SYSTEMS
COMM FEP
MINI
PC
HOST
LOCAL BUYER MASTER LAN
SHADOW SERVER
REMOTE SHADOW LAN
BUYER CLIENT
SOME GEOGRAPHIC DISPLACEMENT WITH INTERVENING NETWORK
PS/2-OS/2

Fig. 6

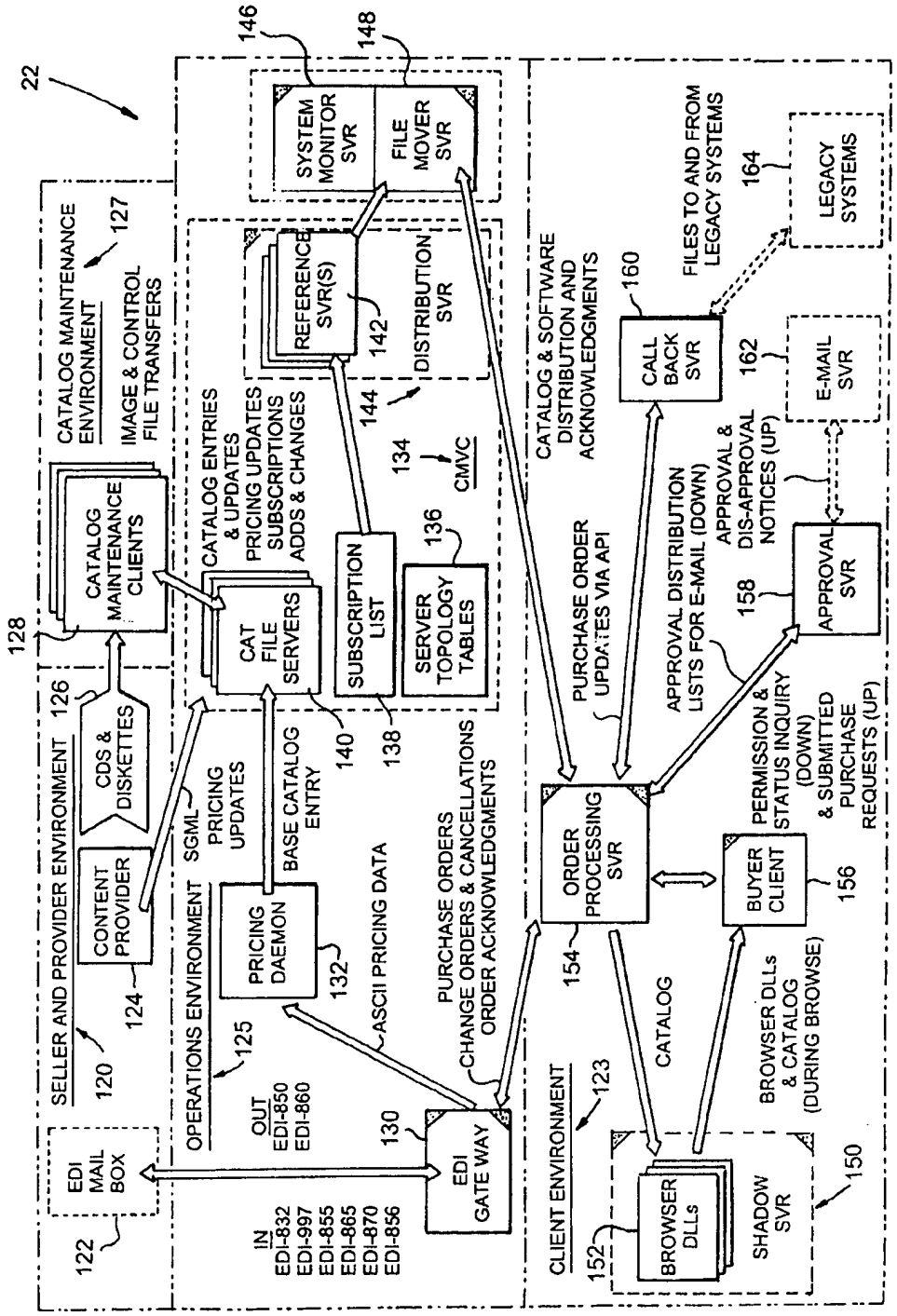

22
146
148
SYSTEM MONITOR SVR
FILE MOVER SVR
CATALOG MAINTENANCE ENVIRONMENT
127
IMAGE & CONTROL FILE TRANSFERS
REFERENCE SVR(S)
142
DISTRIBUTION SVR
144
CATALOG ENTRIES & UPDATES
PRICING UPDATES
SUBSCRIPTIONS ADDS & CHANGES
CMVC
134
CATALOG MAINTENANCE CLIENTS
128
CAT FILE SERVERS
SUBSCRIPTION LIST
136
SERVER TOPOLOGY TABLES
CATALOG & SOFTWARE DISTRIBUTION AND ACKNOWLEDGMENTS
160
CALL BACK SVR
FILES TO AND FROM LEGACY SYSTEMS
164
LEGACY SYSTEMS
126
CDS & DISKETTES
PURCHASE ORDER UPDATES VIA API
APPROVAL & DIS-APPROVAL NOTICES (UP)
162
E-MAIL SVR
CONTENT PROVIDER
SELLER AND PROVIDER ENVIRONMENT
120
SGML
PRICING UPDATES
BASE CATALOG ENTRY
140
138
APPROVAL DISTRIBUTION LISTS FOR E-MAIL (DOWN)
158
APPROVAL SVR
124
PRICING DAEMON
132
ASCII PRICING DATA
PURCHASE ORDERS
CHANGE ORDERS & CANCELLATIONS
ORDER ACKNOWLEDGMENTS
ORDER PROCESSING SVR
154
PERMISSION & STATUS INQUIRY (DOWN) & SUBMITTED PURCHASE REQUESTS (UP)
BUYER CLIENT
156
125
OPERATIONS ENVIRONMENT
OUT
EDI-850
EDI-860
130
EDI GATE WAY
CATALOG
123
CLIENT ENVIRONMENT
BROWSER DLLs & CATALOG (DURING BROWSE)
EDI MAIL BOX
122
IN
EDI-832
EDI-997
EDI-855
EDI-865
EDI-870
EDI-856
BROWSER DLLs
152
SHADOW SVR
150

Fig. 7

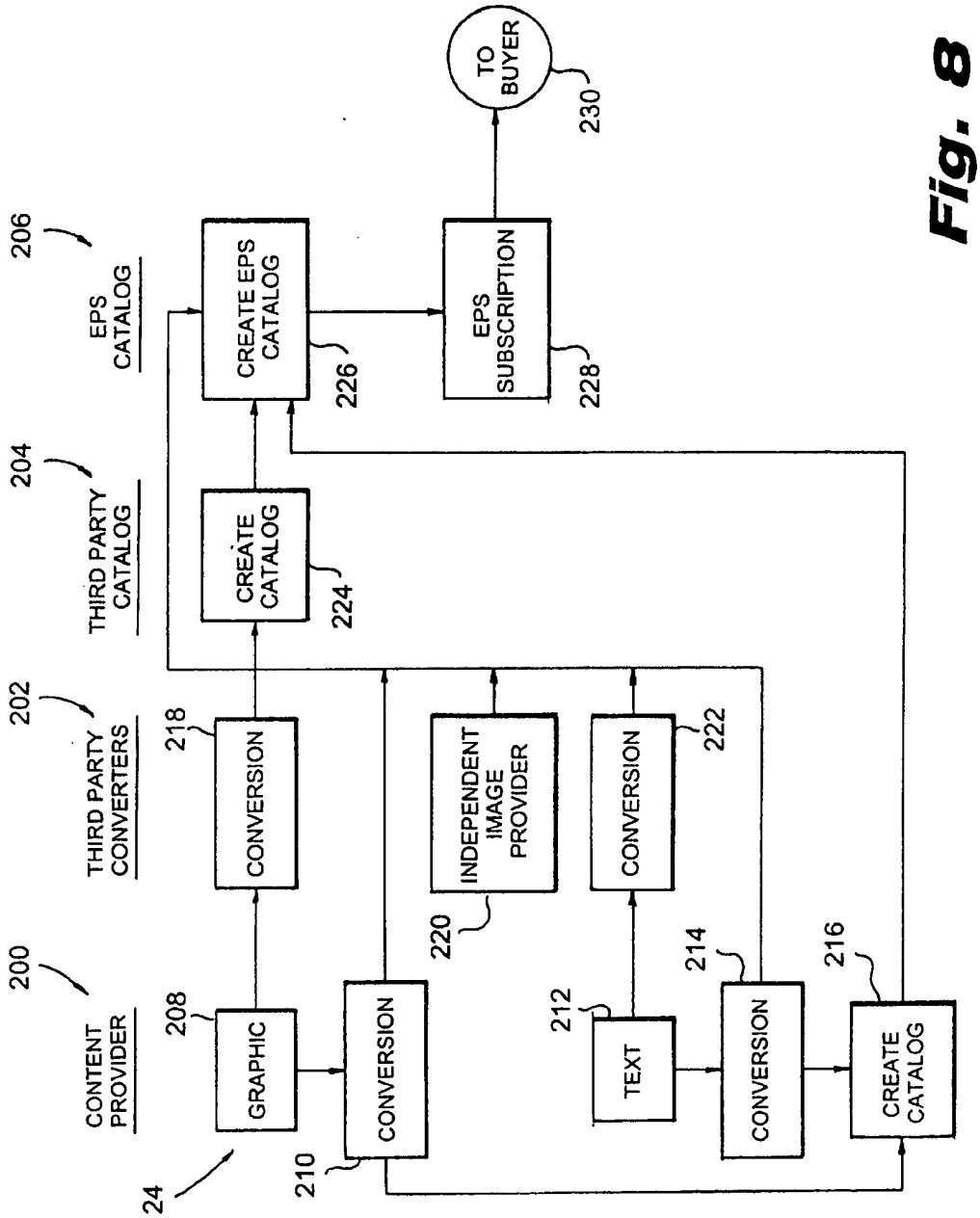

TO BUYER
230
206
EPS CATALOG
CREATE EPS CATALOG
226
EPS SUBSCRIPTION
228
204
THIRD PARTY CATALOG
CREATE CATALOG
224
202
THIRD PARTY CONVERTERS
218
CONVERSION
INDEPENDENT IMAGE PROVIDER
220
CONVERSION
222
200
CONTENT PROVIDER
208
GRAPHIC
CONVERSION
210
212
TEXT
214
CONVERSION
216
CREATE CATALOG
24

Fig. 8

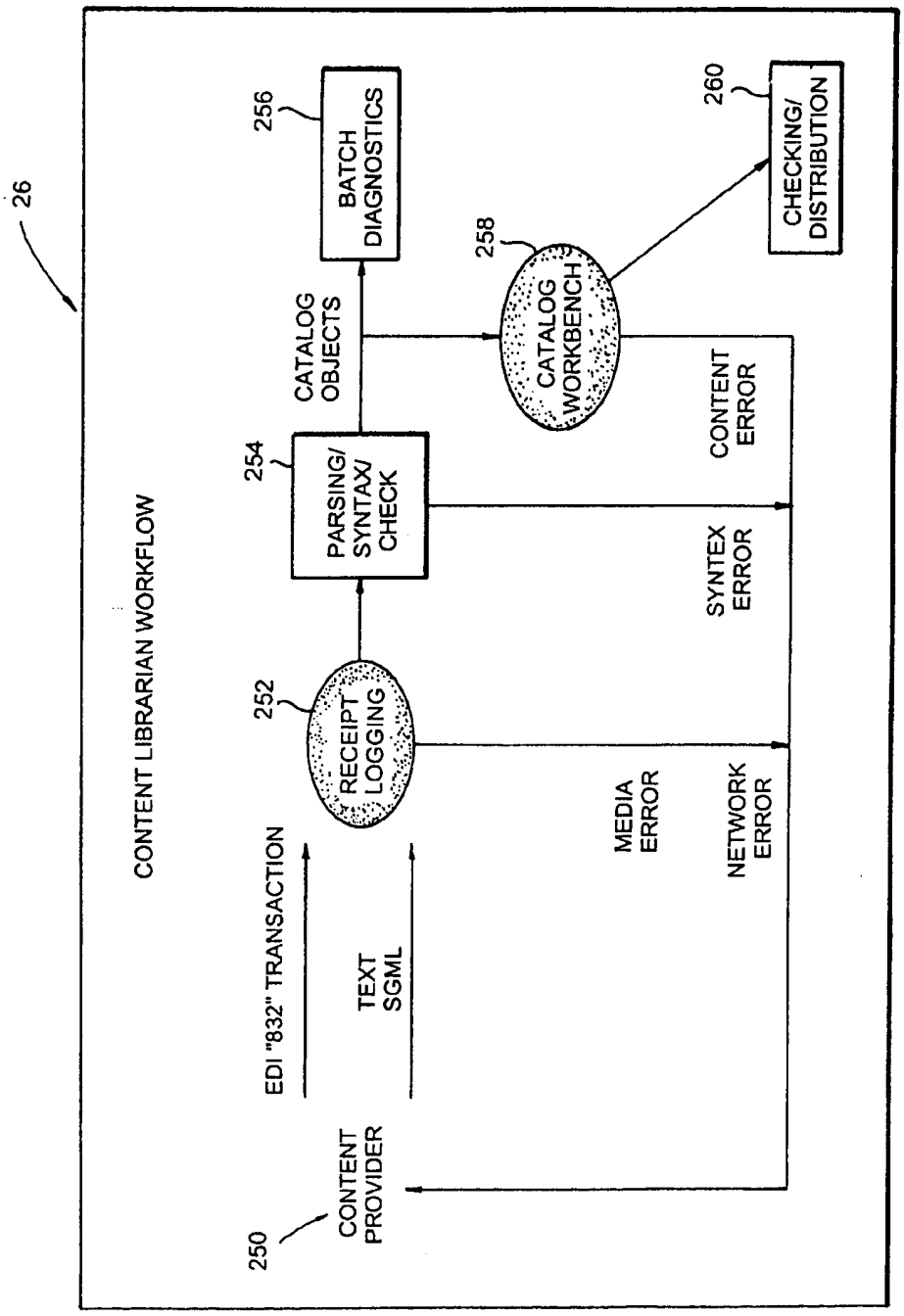

26
CONTENT LIBRARIAN WORKFLOW
250
CONTENT PROVIDER
EDI "832" TRANSACTION
TEXT SGML
252
RECEIPT LOGGING
254
PARSING/ SYNTAX/ CHECK
256
BATCH DIAGNOSTICS
CATALOG OBJECTS
258
CATALOG WORKBENCH
260
CHECKING/ DISTRIBUTION
MEDIA ERROR
NETWORK ERROR
SYNTEX ERROR
CONTENT ERROR

Fig. 9

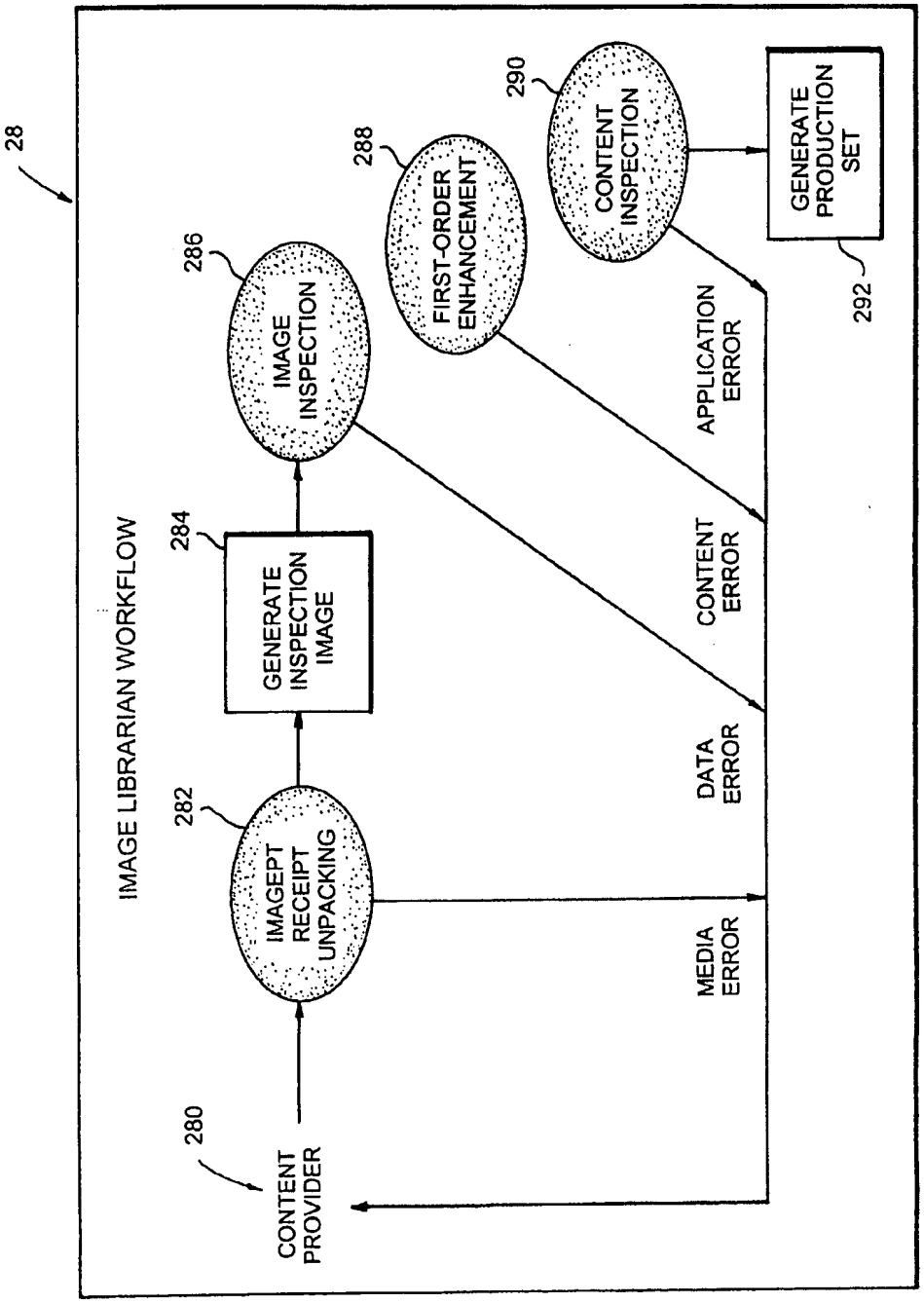

28
IMAGE LIBRARIAN WORKFLOW
280
CONTENT PROVIDER
282
IMAGEPT RECEIPT UNPACKING
284
GENERATE INSPECTION IMAGE
286
IMAGE INSPECTION
288
FIRST-ORDER ENHANCEMENT
290
CONTENT INSPECTION
292
GENERATE PRODUCTION SET
MEDIA ERROR
DATA ERROR
CONTENT ERROR
APPLICATION ERROR

Fig. 10

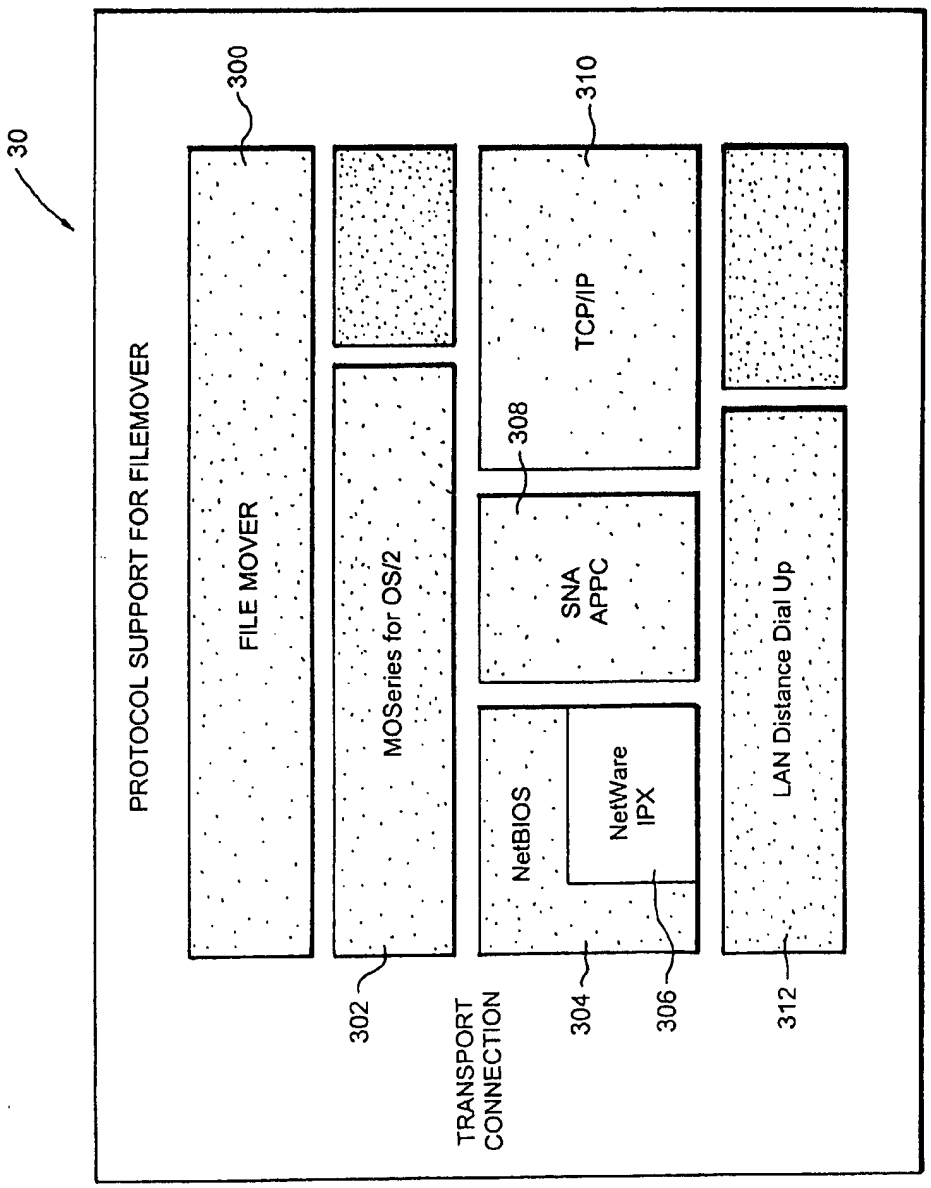

30
PROTOCOL SUPPORT FOR FILEMOVER
300
FILE MOVER
MOSeries for OS/2
302
TRANSPORT CONNECTION
310
TCP/IP
308
SNA APPC
NetBIOS
NetWare IPX
304
306
LAN Distance Dial Up
312

Fig. 11

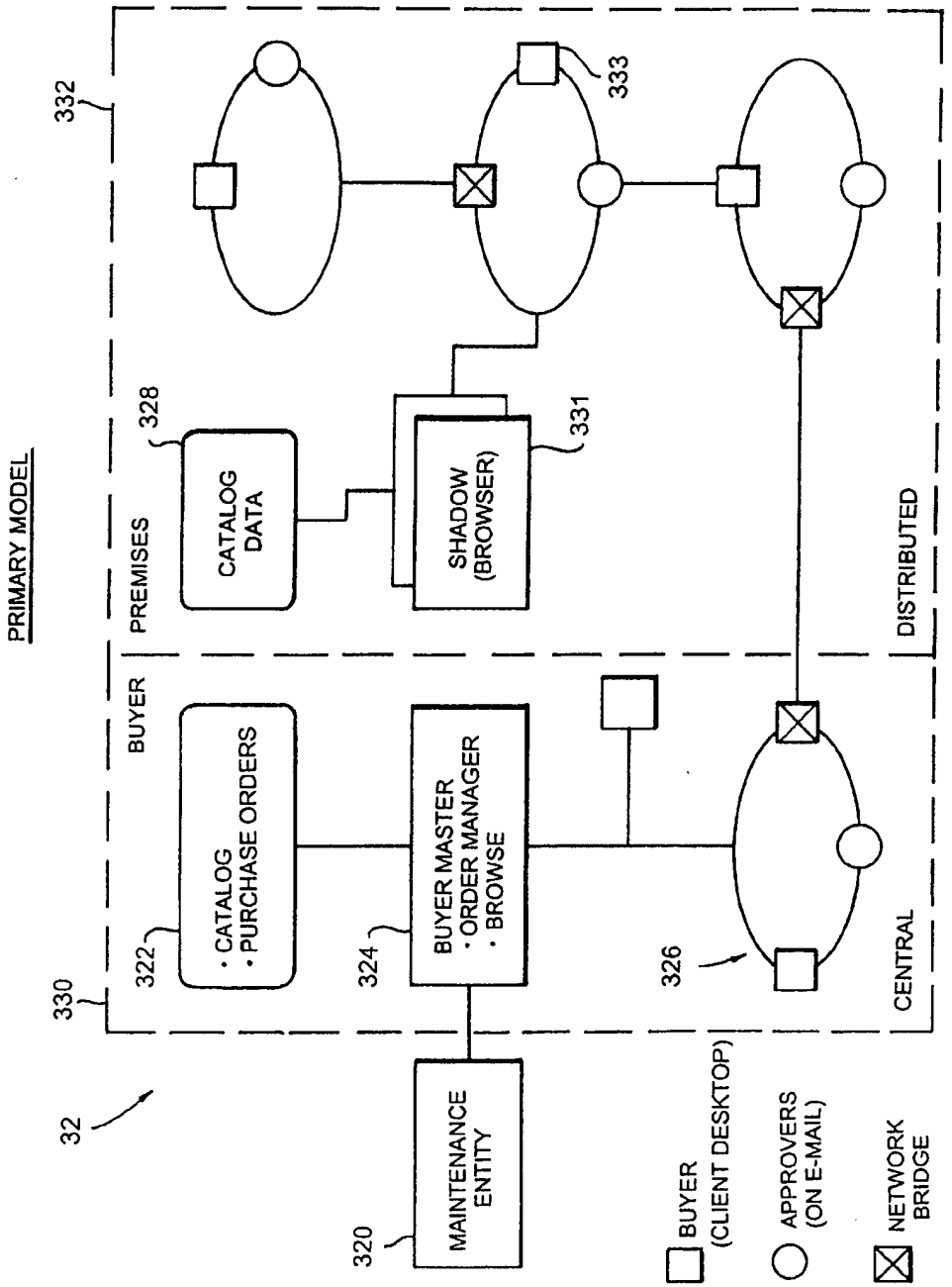

PRIMARY MODEL
32
330
332
333
328
331
322
324
326
320
PREMISES
BUYER
DISTRIBUTED
CENTRAL
CATALOG DATA
SHADOW (BROWSER)
· CATALOG
· PURCHASE ORDERS
BUYER MASTER
· ORDER MANAGER
· BROWSE
MAINTENANCE ENTITY
BUYER (CLIENT DESKTOP)
APPROVERS (ON E-MAIL)
NETWORK BRIDGE

Fig. 12

SYSTEM FOR ORDERING ITEMS OVER COMPUTER NETWORK USING AN ELECTRONIC CATALOG

FIELD OF THE INVENTION

This invention relates to a system for electronically linking a buyer and a seller in a purchasing cycle.

INTRODUCTION TO THE INVENTION

Current procurement procedures in corporations of all sizes are largely manual, or at best semi-automated by electronic mail, and are as a consequence labor-intensive and costly. Typical procedures operate as described below. Refer to the attached drawings, which make the description easier to follow:

1. Typically, an employee requiring some item (such as a piece of office equipment) will look for it in a supplier's catalog. Such catalogs may be at the user's workstation, but are often kept in some central location for general reference (see FIG. **1**, numeral **10**).

2. The employee transcribes information (such as part numbers and price) from the catalog on to a purchase order (FIG. **1**, step **01**).

3. The completed purchase order then normally goes through an approval process, which may, depending on the value of the order and the nature of the items on it, require several sign-offs by people within the corporation with budgetary responsibilities (FIG. **1** step **02**).

4. The purchase order is then sent to the purchasing department of the corporation, which checks the information. These checks include verifying that the items are being ordered from the correct supplier: the same item may be offered by more than one supplier, but contracts are frequently negotiated that require a particular item to be procured from only one of these suppliers, and the Purchasing department has to verify this (FIG. **1**, step **03**).

5. The Purchasing department then sends the Purchase Order to the supplier (FIG. **1**, step **04**).

The process described above can take weeks if not months.

At the other end of the procurement process, printing and distributing the traditional paper catalog is also a labor-intensive and costly process (see FIG. **2**, numeral **12**), especially since catalogs are usually of high quality in terms of art-work and color reproduction (FIG. **2**, step **01**) but may be distributed at no charge to potential buyers. The long production time for a typical catalog (of the order of several months) causes additional problems when it includes items such as personal computers and consumer electronics where prices are highly volatile. Vendors have sought a number of solutions to this problem, the most common being to omit prices from the catalog altogether and issue a separate list of prices (FIG. **2**, step **2**) several times throughout the lifetime of the catalog.

In response to this situation, we now disclose a novel system for ordering items. The system comprises:

1) means for receiving and processing images and text from a plurality of catalog content providers for creating and maintaining one or more electronic catalogs in a central location for subsequent distribution over a computer network;

2) means for receiving supplier's price and catalog changes and propagating them to one or more selected buyers over a computer network;

3) a first end-user computer system comprising user interface and able to access disk storage on a shadow catalog server;

4) a shadow catalog server which comprises a second computer system located within the enterprise whose disk storage can be accessed over a local area network by one or more end-users' computers in an efficient manner; said disk storage being being used to hold (1) one or more electronic catalogs, and (2) program code comprising a a "Catalog Browser" capable of transmitting purchase orders to a master buyer and server;

5) a master buyer server comprising a third computer system located within an enterprise containing (1) program code comprising an order manager and a purchase order workflow which takes purchase orders from one ore more end-user computers and and controls their flow through the enterprise's business processes before transmitting them over a network to the supplier; and (2) a purchase order data base.

The advantages of the novel system are appreciated by contrasting it to the prior art summarized above. In particular, the concept of corporations ordering items from suppliers over a computer network is well-established, and has led to the formalization of EDI (electronic data interchange).

The concept of consumers or end-users (the people who will ultimately make use of an item) ordering items from electronic catalogs over a (usually public) network is also well-established. Public network services such as Prodigy (tm), America On Line (tm) and Compuserve (tm) allow subscribers to their services to select consumer and household items from catalogs placed there by suppliers. The items are typically shipped to the subscriber's home, and the cost charged against a credit card. Such systems have to date only allowed the subscriber to access one supplier's catalog at a time.

It may be noted that neither of the above approaches is a complete solution to the problem addressed by the disclosed invention, which is to allow end-users within a corporation to order necessary items as if they were consumers ordering items for their own use and at their own expense, but to have such orders then flow through the enterprise's normal business controls before being submitted to the supplier. The disclosed invention also goes beyond these solutions in allowing the catalog an end-user sees to be sub-setted and otherwise modified from the supplier's general catalog; in facilitating comparisons between items from several suppliers; and in permitting orders to be generated containing items from several suppliers.

BRIEF DESCRIPTION OF THE DRAWING

The invention is illustrated in the accompanying drawings which:

FIGS. **1** and **2** show prior art purchasing and catalog creation processes;

FIG. **3** shows an end-user environment;

FIG. **4** shows a client environment;

FIG. **5** shows a sample screen for features of the present invention;

FIG. **6** shows an invention topological overview;

FIG. **7** provides an overview of data flow between logical servers;

FIG. **8** shows catalog enablement;

FIG. **9** shows content librarian workflow;

FIG. **10** shows image librarian workflow;

FIG. 11 shows a protocol support for filemover; and

FIG. 12 shows a distributed procurement service.

DETAILED DESCRIPTION OF THE INVENTION

The disclosed invention automates much of the manual processing described above. The disclosed invention preferably is used in the following way (FIGS. 3, 4 numerals 14, 16 illustrate preferred steps involved):

1. An employee 17 preferably accesses one or more electronic catalogs 24 stored on a shadow catalog server 22, accessed via a local area network 20 preferably by means of a employee workstation 18. These catalogs contain only those items for which a price has been negotiated between the enterprise and a particular supplier, so the verification by the enterprise's Purchasing department described above is obviated.

2. The employee selects items from the catalogs preferably with a mouse or similar device. Catalog items may be displayed with pictures, descriptions and other information in a fashion similar to a paper catalog. Where similar items are available, a "Compare" icon can be selected on the screen, causing the items to be listed side by side, with differences highlighted. Items can be located by searching down the taxonomy tree of the catalog (much as one searches through a paper catalog by finding the appropriate general section and then looking for a particular item), or by entering a search word or phrase.

3. Items selected may be accumulated in a "clip-board", a temporary holding area on the user's computer disk. When all required items have been selected, the employee selects a "Submit" icon. This causes the selected items in the clip-board to be sent' to the appropriate approvers as a Purchase Order 30. It should be noted that there is no manual transcription of ordering information from the catalog to the purchase order (since that is performed by the disclosed system).

4. After the order has passed through the enterprise's normal (legacy) business systems, including a workflow definition database 26, a purchase order database 28, and other existing corporate applications 32, it is forwarded to the Maintenance Entity via the Network 34. From there it is sent to the supplier for fulfilment in a traditional way.

5. The employee can at any time review the purchase orders already submitted; cancel them if they have not yet been shipped; and print reports.

The other end of this process involves capturing catalog content (text and images as well as price information) in electronic form. As long as catalog content providers and suppliers continue to publish traditional paper catalogs side by side with the electronic versions, this activity does not displace the current manual process.

The two ends of this automated solution, the supplier side and the buyer side, may be brought together by means of a computer network and associated service offerings. FIG. 6, shows an overall network topology 20 or the initial implementation, with the three major pieces (supplier, buyer and Network Central) clearly distinguished. Suppliers 50 provide e-mail directly to the maintenance entity 100 and to the communications gateway 82 via an EDI mail box 110. Suppliers also provide CD's and diskettes for the to terminals 52 and 54 for the purpose of catalog creation and maintenance. Terminals 53 and 54 communicate with the maintenance entity through Token Ring THORNWOOD 56.

Maintenance Entity 100 consists of a local area network backbone 98 which supports multiple token rings 76 and 94 in addition to a communications gateway computer 82. Token ring 76 services catalog file and reference services computer system 72, catalog and software distribution server 74, and PS/2-OS/2 78. Token ring 94 services system and file monitor server 96 and PS/2-OS/2 92. The local area network backbone 98 further supports and EDI gateway pricing decision computer 80. Catalog maintenance activities are input to the Maintenance Entity 100 from remote terminals 52 and 54 via token ring 56 through T-1 leased lines 62. Application development occurs remotely, item 58, and is communicated to the operations environment through application development Token Ring TORONTO 60 and routed to development server 84.

The client environment is shown in the lower segment of FIG. 6, defined by shadow server 106 which maintains a customized copy of the master catalog for distribution to local clients 102 and 104. Purchase orders are received by a Local buyer master server 86 from a data pathway connecting remote shadow LAN 108 with local buyer master LAN 88. The Buyer Master Server also performs the server function in the following capacities; order processing from buyer clients 90, approval and call back. The Buyer Master Server communicates with the operations environment of the enterprise through a 56 Kb switched or leased TCP/IP line 107.

The Buyer Master Server also interacts with the Range of Legacy Systems which consists of a host computer 64 connected to a COMM FEP 66, a MINI computer 68, and a PC 70. The services provided by the Maintenance Entity distinguish this invention from the electronic catalogs offered by public networks such as Prodigy (tm) and Compuserve(tm), which do no more than route messages from the subscriber to the supplier. The Maintenance Entity services act as a single point of contact to all the suppliers on one side and all the buyers on the other. Existing networks merely link them in a many-to-many relationship. The advantages of this approach are clear: for example, a supplier has only to provide a change to a catalog item once to the Maintenance Entity, which then disseminates it to the affected users.

This aspect of the invention is summarized in FIG. 7, numeral 22 which shows the data flows already mentioned in FIGS. 3, 4 as well as some others which were omitted from the original description for the sake of clarity. The omitted data flows include details specific to both the Operations environment and the Client environment:

1. Details of the Operations Environment 125 Networking software and services software including; a PRICING DAEMON 132 which receives purchase orders, change orders and cancellation order acknowledgments from the ORDER PROCESSING SVR 154 located in the Client Environment 123 via an EDI GATE Way 130. The Pricing Daemon 132 in turn provides pricing updates and base catalog entries to catalog file servers, CAT FILE SERVERS 140.

The operations environment further includes distribution management tools, defined generally by CMVC 134. The CMVC consists of a Subscription List 138 which resides on a server in the form of topology tables 136. The subscription list sources multiple reference servers 142, all of which are contained within a distribution server 144. The reference servers source a combination server comprised of a system monitor server 146 and a file mover server 148.

1. Details of the Client Environment 123

Comprised of a Shadow Server 150 consisting of Browser Dynamic link libraries DLLs 152. The Browser DLLs receive catalog data from the Order Processing Server 154

and in turn output the Browser DLLs and customized catalogs, during a client browse session to a buyer (client) **156**.

The Order Processing Server receives inputs from four separate sources; (1) Buyers (clients) **156** (2) the Approval Server **158** (3) the CallBack Server **160** which services the transfer of files to and from legacy systems **164** and (4) the File Mover Server **148**, which is part of the Operations Environment.

This aspect of the invention preferably comprises (see FIG. **7**) three major components:

1. Catalog creation and maintenance tools (shown at the top of Fig. **7**). Catalog creation is defined by item **122**, the SELLER AND PROVIDER ENVIRONMENT consisting of EDI MAIL BOX 122, CONTENT PROVIDER **124**, and CD's & Diskettes **126**.

Catalog maintenance is defined by item **127**, CATALOG MAINTENANCE ENVIRONMENT, which includes item **128**, CATALOG MAINTENANCE CLIENTS which receives inputs from CDS & Diskettes **126** and additions and changes concerning catalog entries & update, pricing updates, and subscriptions from CAT FILE SERVERS **140**.

2. Catalog browsing and purchasing software (the client environment shown in the lower segment of FIG. **7**); and,

3. Networking software and services (the Operations environment shown in the middle segment of FIG. **7**) defined by OPERATIONS ENVIRONMENT **125**.

Catalog Creation Maintenance

The preferred embodiment is made up of two main elements:

Content mianagement tools to receive, process, and manage images **208** and text **212** from content providers **200** for the creation of an EPS (Electronic Purchasing Service) master catalog. An overview of this process is shown in FIG. **8**, numeral and Text **212** from content provides **200** are first converted through conversion units **210**, **214** also, including conversion units, **218** and **222** from third party converters **202**, the graphics and text are then and combined with content from independent image providers **220** to create catalogs **216** and **224** constituting third party catalogs **204** which are then combined at an EPS catalog stage **206** to form EPS (Electronic Purchasing Service) catalog **226** and distributed to buyers **230** via EPS subscription **228**;

These enable EPS Operations staff to create and manage catalog information in the merchandise database such as the price, description, and visual representation of each item.

Distribution management tools to receive vendors' price and catalog updates, as well as to propagate the changes to the customers' Buyer Master servers.

Content Management Tools

The EPS Content Management tools preferably comprise:

FotoFarm;

Product Editor;

Folder Editor;

Subscription List Editor;

NAM2DAT/NAM2GRP.

FotoFarm

This collection of utilities may be used to convert text and images from the content providers **200, 250** and **280**. The workflows of these two activities are shown schematically in FIGS. **9, 10** numerals **26, 28**. Supported functions may include:

Receive, store, and archive source images **282** and text files **252** and **282**.

First-level validity check of source media **254, 284** and **286**.

Assign EPS unique filename and update the index files **258, 284**.

Create master catalog's subchapters and folders, and populate them with the relevant contents **260 292**.

Trigger down-stream re-creation or subscription catalogs (see below) when EPS catalog updates occur **260 292**.

Process images received from content providers in batch model **256**:

Delta cropping of image by specifying new crop coordinates **288**.

Generate multiple resolution versions of images.

Convert 24-bit to 8-bit dither with palette matching.

Enable re-scheduling of batch process for related information.

Allow multiple images to be proofed at the same time.

Manage registries of **260 292**:

Shared disk storage for various purposes;

Providers of images, text, or EDI content and services;

All top-level books in the EPS Catalog Server.

Product Editor

This ITS (Iterative Transaction Systems) application enables EPS Operations staff to:

View multiple product descriptions at a time;

Associate images with product handle;

Save, import, and create templates;

View and edit product descriptions.

Folder Editor

A sample screen from this tool is shown as FIG. **11**, numeral **30**. This tool enables Operations Staff to:

View master catalog space.

Organize and arrange products into groupings, i.e., manipulate Catalog topology.

Search: Keyword, Power Scarch (Attribute, Taxonomy).

Subscription List Editor

This uses code from the Folder Editor and Search Engine, with additional functions, to enable Operations staff to:

Save subscription profiles;

Update/edit Distribution Frequency via manual operation;

Update/edit Distribution Frequency automatically;

Generate flat or hierarchical browser space;

Send newly created subscription list to Catalog Server.

NAM2DTA/NAM2GRP

NAM2DTA is a stand-alone GML parser that converts tagged source files to catalog objects. NAM2GRP is a stand-alone GML parser that converts tagged source files to catalog folders.

Distribution Management Tools

Distribution Management concerns itself with getting data from Network Central out to the customers' computers on the network in such a way that each computer receives only that data (catalog items and price information) which it needs. The EPS Distribution Management tools preferably comprise:

Distribution Manager with GUI query tool;

Catalog daemon (CATD);

FileMover.

Distribution Manager

Responsible for

Price Update (Catalog Monitor);

Catalog Update (Catalog Monitor);

Automated EDI Processing and Distribution (Update Daemon);

Acknowledgement Processing;

Update DB2/2 Tables.

Catalog Daemon (CATD)

This software runs in customers' servers and polls mailboxes to apply updates, and preferably monitors channels for action objects including: Images; Applications; Prices; Catalog descriptions. It preferably can Execute action specified in action object; Forward acknowledgement objects to parent; and is Used together with FileMover daemon to verify file movement.

Filemover 300

This is the communication layer of EPS which moves files between systems. In particular, it drives the movement of data throughout the network for price up-dates and purchase orders.

Filemover uses a simple mail-like mechanism in which files are moved from OUTBOX directories to INBOX directories, which can span network attached systems. It has no knowledge of the type or structure of the file it moves, and treats them all as binary blob data. Hence no code page translation or character set translation is attempted.

Filemover is a Point-to-Point protocol and does not provide any internal routing mechanism. Routing can be provided outside of the Filemover, however, by:

Utilizing the routing mechanisms of the underlying protocols, e.g., TCP/IP. Will only work across machines running in a single internetwork with the same protocol.

Using Catalog Daemon (CATD) to provide routing by forwarding files across intermediate nodes. It works across internetworks with different communication protocols but its network path must be hard-coded within the catalog files being sent.

Filemover enables the EPS to:

Move files of any size and takes care of splitting and reassemblying the files when the underlying communication software has a limitation on the file size.

Verify and confirm both file movement and ability to move files (e.g., checks disk storage).

Support file movement over systems connected with multiple protocols (shown schematically in Fig. **11**):

IPX/SPX **306**

NetBIOS **304**

TCP/IP **310**

Support file movement over:

Dial-up connection (SLIP and LAN Distance **312**) via modems

Dedicated LAN or WAN connection

Support Store and Forwarding of files **302**.

SNA APPC **308**

Client Environment

Recall that the Client Environment (FIG. **7**) comprises two principal components:

1. An electronic catalog in a format that can be browsed, searched and ordered from, by a corporate employee with no training in Purchasing procedures;

2. Software that controls the flow of a purchase order through an enterprise's procurement procedures.

The preferred embodiment of the above software and related manual processing minimizes data storage requirements and maximizes the responsiveness of the total system preferably by employing a primary model consisting of two major components, a buyer side component **330** which communicates over a network bridge with a premises component **332** (see FIG. **12**, numeral **32**):

1. An end-user computer system **333** attached to a Local Area Network or LAN, containing the usci interface;

2. A "shadow catalog server", **331** (FIG. **12-2**) with disk storage that can be accessed over a LAN by one or more end-users' computers, the disk storage being used to hold one or more electronic catalogs **328** and program code **331** to enable browsing of the catalog and transmitting purchase orders to the "buyer master server" **324**;

3. A "master buyer server" **324** (FIG. **12-3**), which is a computer system within the enterprise containing (1) program code (described below) which can take purchase orders **332** from one or more end-user computers and control their flow through the enterprise's business processes, as described under "Workflow" below, before transmitting them over a network to the supplier via the Maintenance Entity **320** and (2) a to a Purchase Order data base **322** that can be accessed over a LAN **326**.

A preferred embodiment of the above comprises:

Order Manager and Catalog Browser

This function runs on the end-user's personal computer, although the code would normally reside on disk storage in a catalog shadow server machine. It provides the following main function to an employee using the system:

Log on/Password Security

Login

Log into EPS

Track User ID for all transactions arising from this session.

Additional Order Manager functions may be enabled or disabled based on the login profile.

User selects from list of authorized users.

Catalog Browser

Browse Product Images, Text and Prices

Able to page forward or backward.

Quick return to top menu page from any part of the catalog.

Quick return to the table of contents from any part of the catalog.

Display previous page at top of screen, with links to navigation log.

Images are displayed in .BMP format.

Two separate image files are kept for OS/2 and Windows. See also "FotoFarm", supra.

Text The Browser may select zero, one, or more ordered sets of descriptive phrases.

Prices.

Select Product Based on Single Keyword

Based on index search.

Index search is launched with user's action on an icon represented by a magnifying glass.

Search by product type or manufacturer's name.

Copy to clipboard for further processing.

Compare Products (max. 4)

Compare up to four items from the same category.

End user selects this option by clicking on a "Compare" icon represented by a scale.

Varying features amongst the compared products are highlighted in bold text.

Product Clip Board

Select items on Product Listing for adding to clipboard.

Add item on Product Page to clipboard.

Delete an item in the clipboard.

Change the quantity of an item in the clipboard.

Clear the clipboard to remove ALL items.

Save the clipboard (to a file).

Submit the clipboard (as a purchase request).

Show the items on the clipboard.

View clipboards (i.e. saved clipboard files).

Purchase Request Generation Select the recipient of the purchased items from a list. The recipient list is kept in a local disk, and its entries can be added, changed, or removed.

Classify all line items into capital and expense items.

Ask for budget number for capital items.

Ask for engagement number for expense items.

Display generated purchase request for confirmation.

Select approver from list to submit request to.

Add comments to purchase request.

Send purchase request to approver.

Save purchase request as clipboard.

Cancel submission of purchase request.

Print Clipboard: This function is in addition to, and separate from, the report generation functions which use DB2/2 report generators. It enables users without access to DB2/2 to print a clipboard or submitted order from their own workstations.

The supported functions include:

Generate printed output from client application for the contents of the clipboard.

Can also be used for printing a submitted order.

Able to generate output for various printer formats including Postscript. May have to go through some type of metafile generation process.

Needs to work in both OS/2 and Windows.

Purchase Order Creation

Multiple Sellers on One PO

Each line item in a purchase request could be sent to a different vendor. This requires that information such as the shipping and billing address be stored on a line item level, rather than at the header level for a purchase order. These multiple sellers include those whose products are not listed on the catalogs.

Electronic PO

This is to forward the purchase orders electronically to the vendors via the EPS. system. Data includes type of transaction, required data as defined by EDI standards for a **850** PO such as PO number, date, name & address, customer ID, customer master record for shipping and billing information.

Print Paper PO

Print PO by vendor in a multi-vendor PO

Sub-function of the common printing functions described in "Report Generation", infra.

PO Processing

Manual Status Update

Purchaser can update status of PO manually after receiving acknowledgements, status updates, etc. from vendors via fax, phone, or mail. Changes to the PO can then be saved to the DB2/2 database on the Purchasing Server.

Line Item Modifications by Client

The quantity of line items can be increased or decreased prior to order submission. After an order has been submitted, the quantity can only be decreased.

The quantity of line items can be decreased to zero.

A line item can be deleted once an order has been placed with a vendor and is being fulfilled by the vendor.

Allow client to modify other fields such as requested ship date, shipping and billing address, add comments to line items (e.g., a banking institution).

Possibly allow client to switch partnumbets, delete line items, add new line items.

Change Logging/Reporting

Changes to the POs are recorded in the logs and can be accessed by the report generation functions.

PO Maintenance

Browse POs

Group existing POs in ciapteus with summary information including:

Request number.

Requester.

Recipient.

Request date.

Total price.

Line of Business.

Scroll through all line items.

Sort line items by column headings in the following order:

Sort numeric columns from high to low or low lo high.

Sort alphabetic columns from A to Z or Z to A.

View details of line items by clicking on them.

Search for specific groups of POs and purchase requests by Requester Name, Requester Date, and Request Number. The search results can be grouped into a chapter.

View Approvers

Enables user to look up list table of associated approvers for a PO.

Approvers are item-based; i.e., each item has its own approver.

Enables user to view approval data for each item, with the approvers name, decision, and date of action.

Check Status

Enables users to check current status of POs. * When orders are placed, vendors send acknowledgements and status messages via EDI. These are reflected in the updates to the status of line items, with the date of the status change.

The approval status of each order or request can also be checked.

Cancel POs

Enables users or administrators to cancel POs or purchase requests. This is dependent on whether the order has passed the deadline for the change to be effective. Vendors restrict the set of order states against which a PO can be canceled. For example, if the item has been shipped, the order cannot be canceled. EDI Vendors must be able to support Cancel/Change **860** transactions and their subsequent acknowledgements.

The end user will be prompted for confirmation of cancellation request prior to processing.

Upon confirmation of cancellation, the order is moved to the Canceled Requests chapter.

Note

If the PO has already been sent to the vendor, an additional EDI (**860**) transaction is generated and budgets credited.

Add Approvers

This function is required for customers who are not using e-mail approval.

Requires end-user interface to be modified to make the approver line items editable.

Changes must be saved back to the database.

Delete Approvers

This function is required for customers who are not using e-mail approval.

Order Manager Admistration

Budgets

All line items for capital purchases are charged against the capital expense budgets.

Budget Information: Each budget has the following information:

Budget number

LOB (line of business)

Line of business related to the purchase.

Allocated

Amount allocated to the budget.

Current Requisition

Amount associated with all active orders.

Ordered

Amount for orders that have been sent to vendors.

Balance

Balance amount available in the budget.

Active

Yes for an active budget.

No indicates a budget that has been closed and no expenditure can be charged against it.

Create new capital budget: The following information is preferably required:

Budget number

Amount allocated

Amount allocated to the budget.

Active status

A Yes to indicate that it is active.

LOB (line of business)

Line of business the budget is assigned to.

Description of budget

Brief description of the purpose of the budget.

Change existing budget: Changes can be made to the following aspects of the capital expense budget:

Amount allocated

Amount allocated to the budget.

Active status

A Yes to indicate that it is active.

Description of Budget

Brief description of the Purpose of the Budget.

All changes are logged to the change history log, which can be viewed.

Delete existing budget: This function may be used to clear existing budgets at the end of a fiscal year.

There will be a prompt for the user to confirm deletion of the budget amount.

View budget history

All changes to the allocated amount and status of the budget, as well as all expenditures are logged.

Each transaction is logged with a brief description of the activity attached.

The last 100 transactions are logged.

This view function is applicable to both active and inactive budgets.

Import budget guidelines: This is to enable the import of budgets from SAP, or another accounting interface, for the initial budget creation.

Track budget: All line items in a PO get charged to either an expense or capital budget. Any modifications to the PO requires that the budget balances get updated.

User Profiles

The following functions are provided:

Add new users Authorize new users to the list of authorized users.

Delete User

Update current user profile

Ship/Bill Update (Per Site)

This is to enable the purchasing administrator to maintain the shipping and billing addresses of all locations within a Customer enterprise. These addresses are referenced by POs to define the shipping and billing destinations. The supported functions include:

Add new address;

Update current address;

Delete current address;

Vendor Info Update

This is to enable the purchasing administrator to maintain the EDI vendor addresses for confirmation of shipment and billing, as well as status updates. The supported functions include:

Add new address;

Update current address;

Delete vendor address.

Define Company Policy For Captial/Expenses Purchases

Line of Business

Add new line of business;

Update line of business information;

Delete line of business.

Report Generation

This includes the common printing functions for both the reports and purchase orders. They include:

Commodity reports;

Line cost reports;

Order modification reports;

Budget modification reports;

Customized reports.

Approval Workflow

Approval workflow is controlled by the Approval Manager residing in the Purchase Server in the customer's site. This workflow of the purchase orders between the customer and vendors is enforced by a PO approval process defined by the customer. Its functions include:

Keep track of a PO's approval status from the moment a purchase requisition is generated. Appropriate actions are taken to forward the purchase requisition to the predefined approvers to be approved or rejected.

Interface with the customers' electronic mail systems to post approval notifications for the necessary action by designated PO approvers.

Provide separate ITS client application to allow PO approvers to approve purchase requisitions directly from within the EPS system rather than from the external email system.

Approval Policy Configuration

Set up Lotus Notes DB to specify approver hierarchy.

Use of REXX code to customise approval hierarchy.

Approval Data

Store approval data for POs in DB2/2 PODB;

Store list of approvers in Lotus Notes;

Entry point API (call-out) to support accessing approvers from external systems.

Approval List Generation

Print approver Lists from Lotus Notes;

View approver Lists from Lotus Notes;

Lotus Notes interface to create and update approvers list (company wide);

REXX code to specify approval policy given PO and list of approvers;

Generate Approvers service application **158** to communicate with client server API CORDER PROCESSING SVR **154** (per PO).

Approval List Processing

Approvers can receive email messages via an E-MAIL SERVER **162** notifying them that they need to approve various purchase requisitions.

Mail routing support is available for Lotus Notes, cc:Mail, and Microsoft Mail.

Snapshot Database Within Lotus Notes

This is a function to synchronise the information between the EPS Server and the Lotus Notes server.

Help Functions Within Lotus Notes

A help database is available from within Lotus Notes as a Notes database.

Approval Manager Client

This ITS client application is for approvers who do not want to receive approval notification from an email system external to EPS. It enables approvers to log on to the EPS Purchasing Server and approve or reject purchase requisitions.

PO Workflow

The flow of the purchase order through an enterprise's approval and other financial processes varies with each enterprise. The disclosed system contains workflow logic implemented as a Finite State Machine. This is a table specifying how the system is to change state in response to specified inputs, and what actions it should take when each transition takes place. Such a table can be easily tailored to fit the needs of a particular enterprise. Application Program Interfaces (APIs) in the generic state transitions supplied with the system allow an enterprise to invoke and pass information to and from existing computer applications and data bases (which could include the enterprise's "legacy" purchasing system) as shown in FIG. **4** step **02**.

In the preferred embodiment, The EPS Client/Server application programming interface (API) provides client applications with a set of functions and action calls to communicate with the EPS Server for managing purchase orders within the customer's environment. It can also be used by any customer applications to work with the data available from the server.

The API supports three types of client applications:

Interactive Transaction System (ITS) applications

These are clients written with the ITS toolkit and using the ITS runtime to provide the user interface.

Non-ITS applications

These are clients that have user interfaces other than ITS.

EPS system extensions

These are ITS and non-ITS applications registered with the Purchase Order workflow of the EPS server, and can be classified into two categories:

1. EPS Monitors

Registered against a certain state in the Purchase Order workflow and are notified whenever any purchase request enters that state. The notification will be received asynchronously with the purchase request continuing within the workflow.

2. EPS Services

Registered with the EPS Server and introduce a new state in the Purchase Order workflow. They are notified whenever any purchase request enters that state, and are expected to notify the EPS Server when the specific task is completed.

API Architecture

A brief description of the API architecture is necessary for an understanding of the API functions and action calls. Essentially, the API is made up of five layers, as shown in FIG. **5**:

X layer **38** This is the ITS application layer which interfaces with ITS client applications to deliver ITS client application requests to the C layer for onward transmission to the Buyer Master.

Y layer **40** This is the non-ITS application layer which interfaces with non-ITS applications to deliver non-ITS client application requests to the C layer for onward transmission to the Buyer Master.

C layer **42** This is the common layer that interface the X and Y layers with the M layer. It takes application level data structures from X or Y layers, converts them into low level communication data buffers, and invokes M layer functions with these data buffers to communicate with the EPS Server.

M layer **44** This message layer is the lowest level EPS API communication layer. It uses the ITSCOMM **48** API to handle protocol specific communication functions. It handle communications data buffers instead of application level data structures.

S layer This is a server interface layer and handles functions between the C layer of EPS Server and the OM Server layer **47**.

In addition, the EPS Client/Server API has a set of OMServer APIs to support client requested actions on the EPS Server from the S layer **46**.

APIs

Logically, the EPS Client/Server APIs can be grouped into four areas:

Information

These include the functions and actions to Get and Save data of predefined datatypes to the EPS Server.

Monitors

Services

Security

These validate clients and restrict the level of access. These include: Logon, Logoff, Connect, and Disconnect.

THE NETWORK ENVIRONMENT

"Network Central" (shown in the middle of both FIGS. **6**, **7**) consists of one or more computers and program code of the type located in IBM's Advantis network, which provide four principal functions:

1. receipt of purchase orders from the master buyer servers of one or more enterprises;

2. passing EDI transactions to and from suppliers;

3. storing catalog information for transmission to buyers;

4. the distribution of price information.

In addition, personnel at Network Central may perform many or all of the activities described under "Catalog Creation/Maintenance" above.

Overview of EDI

The Electronic Data Interchange (EDI) is a standard for the exchange of business data. It defines:

Communication wrappers, which are usually handled by a communication package from a Value Added Network (VAN) providing EDI mailboxes).

The ASCII character set.

Various transactions, each with an ID

The order and hierarchy of data within each of the transactions.

The type and length restrictions for each piece of data.

There are two major EDI standards—ASC X12 which is the standard for the United States, and UN/EDIFACT, which is the general standard adopted by countries outside of the U.S.

EPS EDI Implementation

Customers may be connected to a system like the IBM &EPS. via non-EDI links, sending their purchase orders over 56khs lines. The EDI Gateway translates and maps these communication into EDT messages before using the FileMover mechanism to send them to vendors via its EDI mailbox on the Advantis network. Vendors' acknowledgements and status updates are transmitted as EDI messages to the Advantis mailbox. The EDI Gateway translates them to the EPS format and updates the PO status accordingly.

Currently, the EDI Gateway consists of the EDILISTS application as well as the IEBASE program provided by Advantis to connect to the Advantis network using LU6.2 communication protocol. The gateway logs and tracks all EDI transactions for diagnostic purposes; it can also alert the Network operator for the necessary recovery action when it encounters any unexpected event.

The preferred embodiment supports the following EDI transactions:

832-Create Catalog Content.

850-Purchase Order.

855-Order Acceptance.

856-Shipping Order Status.

860-Change/Cancel Order.

865 and 870-Order Status.

997-Acknowledge Receipt of Order.

Other Gateway Functions

Gateway EDI in-box and PO in-box monitoring

Look for new PO request and translate to EDI.

Look for new EDI transaction and translate to EPS internal format.

Poll EDI mailbox hourly if not done via PO transactions.

Execute utility to access Advantis's mailbox using IEBASE

Upload EPS-generated EDI to VAN.

Download any waiting EDI message.

Directory browsing.

PO lookup, browsing and merge update. Look up and browse archived PO files.

PO/EDI error logging.

Reports all errors and alerts system operator for attention in the event of a major error taking place.

Logs problems to a flat file.

Event tracking and logging.

Catalog tools linking for 832 transactions.

Archiving POs to multiple customer/vendor file systems.

What is claimed:

1. A system for electronically ordering items within an enterprise comprising:

a maintenance entity. located outside said enterprise, for receiving price and availability data from a plurality of distributors and means for receiving and processing images and text of catalog data from a plurality of catalog content providers for creating and maintaining one or more electronic master catalogs in a central location for subsequent distribution to a plurality of shadow catalog servers distributed throughout said enterprise, where said shadow servers contain data representing a customized electronic catalogue from said master catalogs, over a computer network, said maintenance entity comprises:

means for constructing said customized catalog from said master catalogs;

means for receiving a supplier's price and catalog availability changes from a plurality of said distributors and propagating them to one or more selected buyers over said computer network;

means for receiving catalog changes from a plurality of said catalog content providers and propagating them to one or more selected buyers over said computer network;

one or more computer systems, maintained by said maintenance entity, and having means for creating and transmitting to a plurality of shadow catalog servers within said enterprise, images and text of a plurality of catalog items offered by said content provider and price and availability data from said suppliers; said enterprise comprises:

a plurality of first end-user computer systems geographically distributed throughout said enterprise comprising a user interface and able to access disk storage on said shadow catalog server, and having means for electronically ordering said catalog items from said shadow catalog servers;

said shadow catalog servers, which comprise a second computer system whose disk storage can be accessed over a local area network by one or more first end-user's computers; said disk storage being used to hold and maintain (1) one or more customized electronic catalogs, and (2) internal program code comprising a Catalog Browser capable of transmitting purchase orders to a master buyer and server, and having means for allowing an end user to view said customized electronic catalog in order to facilitate comparisons between catalog items from several suppliers, and in permitting orders to be generated containing items from several suppliers;

said master buyer server comprising a third computer system located within said enterprise containing (1) purchase order workflow software comprising an order manager and a purchase order workflow which takes purchase orders from one or more end user computers and controls their flow through said enterprise's business processes before transmitting them over a network to the supplier; and (2) a Purchase Order data base; and

means for said master buyer server to receive information from and transmit information to said supplier.

2. A system according to claim 1, further comprising a means for specifying, subscription information comprising a mapping between a plurality of supplier's catalog items and one or more buyers for indicating which catalog items can be propagated to each buyer's catalog server, where said mapping is unique to each said buyer's catalog server.

3. A system according to claim 1, further comprising a means for specifying, pricing information comprising a mapping between a plurality of supplier's catalog items and one or more buyers for indicating which catalog items can be propagated to each buyer's catalog server, where said mapping is unique to each said buyer's catalog server.

4. A system according to claim 1, further comprising an EDI gateway wherein EDI transactions between one or more distributors and said maintenance entity are converted to

pricing, catalog availability and purchase order transactions between one or more customers and said maintenance entity, and wherein EDI transactions between one or more suppliers and said maintenance entity are converted to catalog update transactions between one or more customers and said maintenance entity.

5. A system according to claim 1, further comprising a means for enabling said purchase order workflow software to be mapped to the business processes of an enterprise.

6. A system according to claim 1, further comprising mapping tables constructed by said maintenance entity for identifying suppliers, manufacturers, content providers, catalogs, catalog items and buyers for uniquely identifying each, whilst allowing said suppliers, manufacturers, content providers and buyers to continue to use the naming conventions established within their organizations.

* * * * *

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United States Patent [19]

Gupta et al.

[11] Patent Number: 5,825,651

[45] Date of Patent: Oct. 20, 1998

[54] METHOD AND APPARATUS FOR MAINTAINING AND CONFIGURING SYSTEMS

[75] Inventors: Neeraj Gupta; Venky Veeraraghavan; Ajay Agarwal, all of Austin, Tex.

[73] Assignee: Trilogy Development Group, Inc., Austin, Tex.

[21] Appl. No.: 707,187

[22] Filed: Sep. 3, 1996

[51] Int. Cl.[6] G06F 1/00

[52] U.S. Cl. 364/468.09; 364/488

[58] Field of Search 364/468.09, 468.02, 364/468.03, 468.1, 488; 395/651

[56] References Cited

U.S. PATENT DOCUMENTS

4,796,194	1/1989	Atherton .	
5,019,961	5/1991	Addesso et al.	364/192
5,019,992	5/1991	Brown et al.	364/468
5,355,317	10/1994	Talbott et al.	364/468
5,357,440	10/1994	Talbott et al.	364/467
5,586,052	12/1996	Iannuzzi et al.	364/512
5,659,478	8/1997	Pennisi et al.	364/468.01

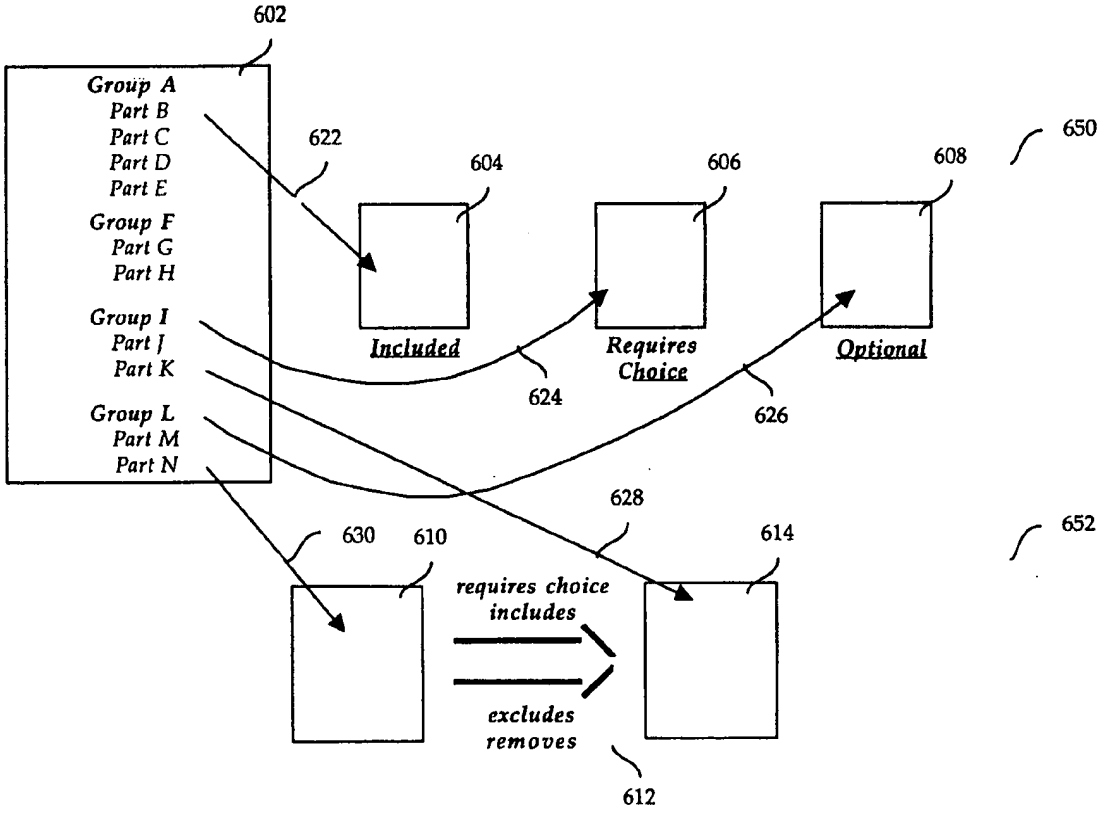
Primary Examiner—Kevin A. Kriess

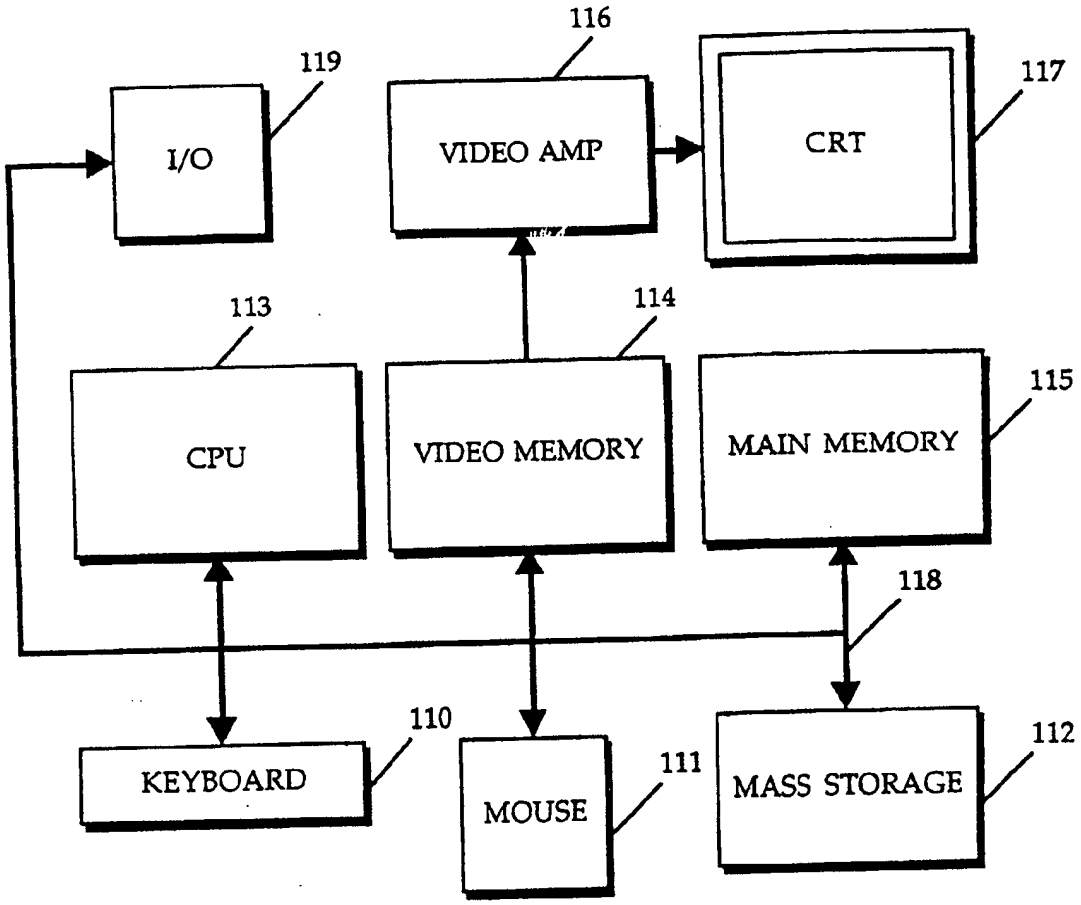
Attorney, Agent, or Firm—Hecker & Harriman

[57] ABSTRACT

The invention provides the ability to interactively select and configure a product among a set of related products based on availability and compatibility of features and options. It does not impose an order in the selection of products, features or options; only valid selections can be made at any time. To create an electronic representation of the product information to achieve the above goal, the invention provides a framework for defining a systems by defining the components of the system using elements contained in a parts catalog and defining relationships between the components of a system. A configuration system validates a configuration using the system definition, the current state of the configuration and user input.

85 Claims, 24 Drawing Sheets

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I/O
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CRT
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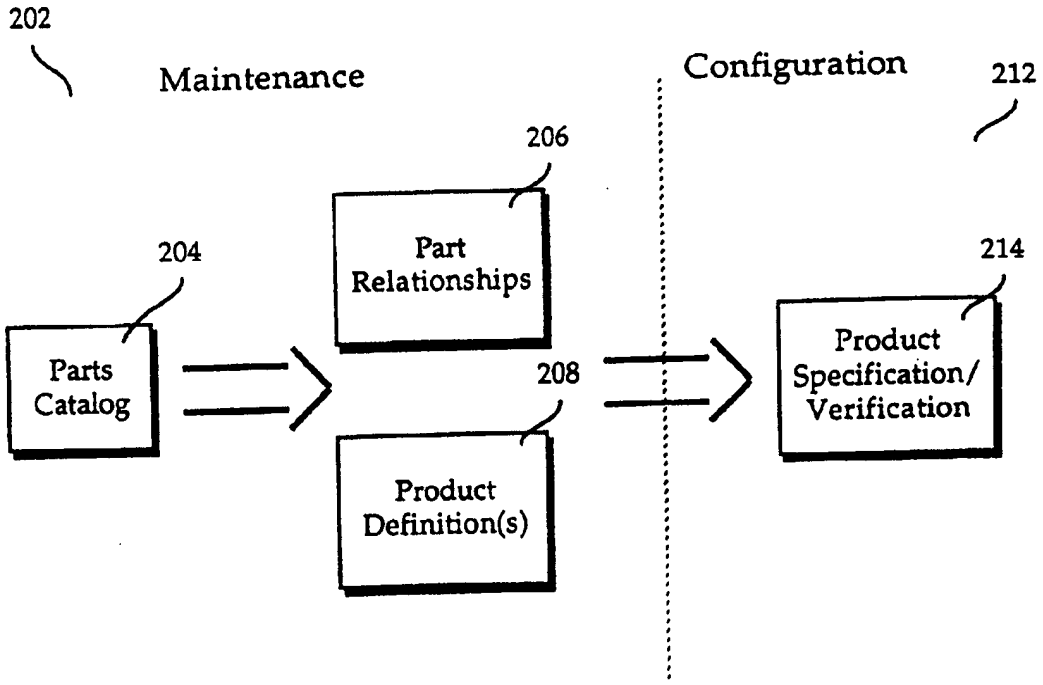
VIDEO MEMORY
MAIN MEMORY
118
110
112
KEYBOARD
111
MOUSE
MASS STORAGE

FIG. 1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Configuration
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206
Part Relationships
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214
Parts Catalog
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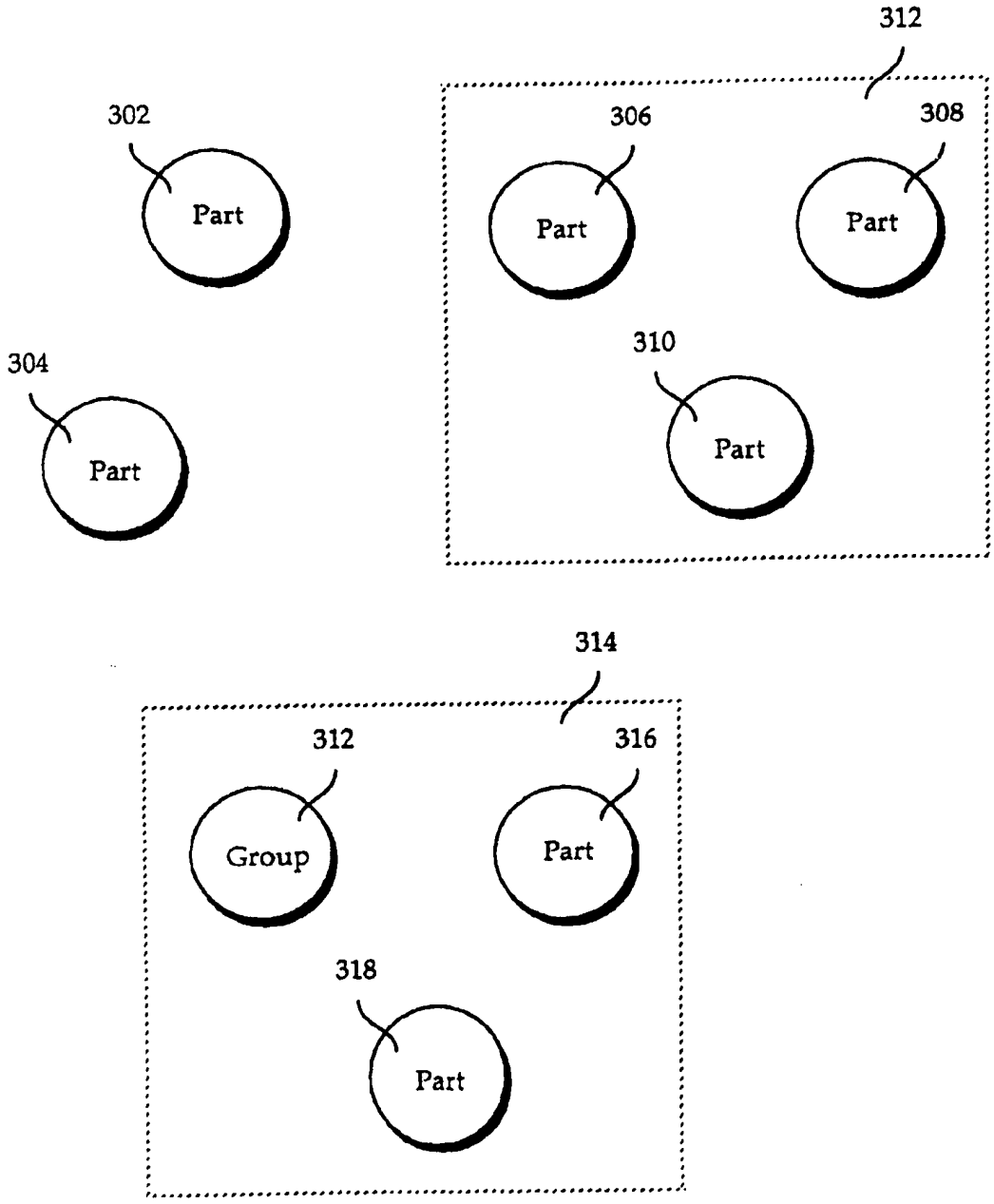
Product Specification/ Verification
Product Definition(s)

FIG. 2


312
302
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Part
Part
Part
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Part
Part
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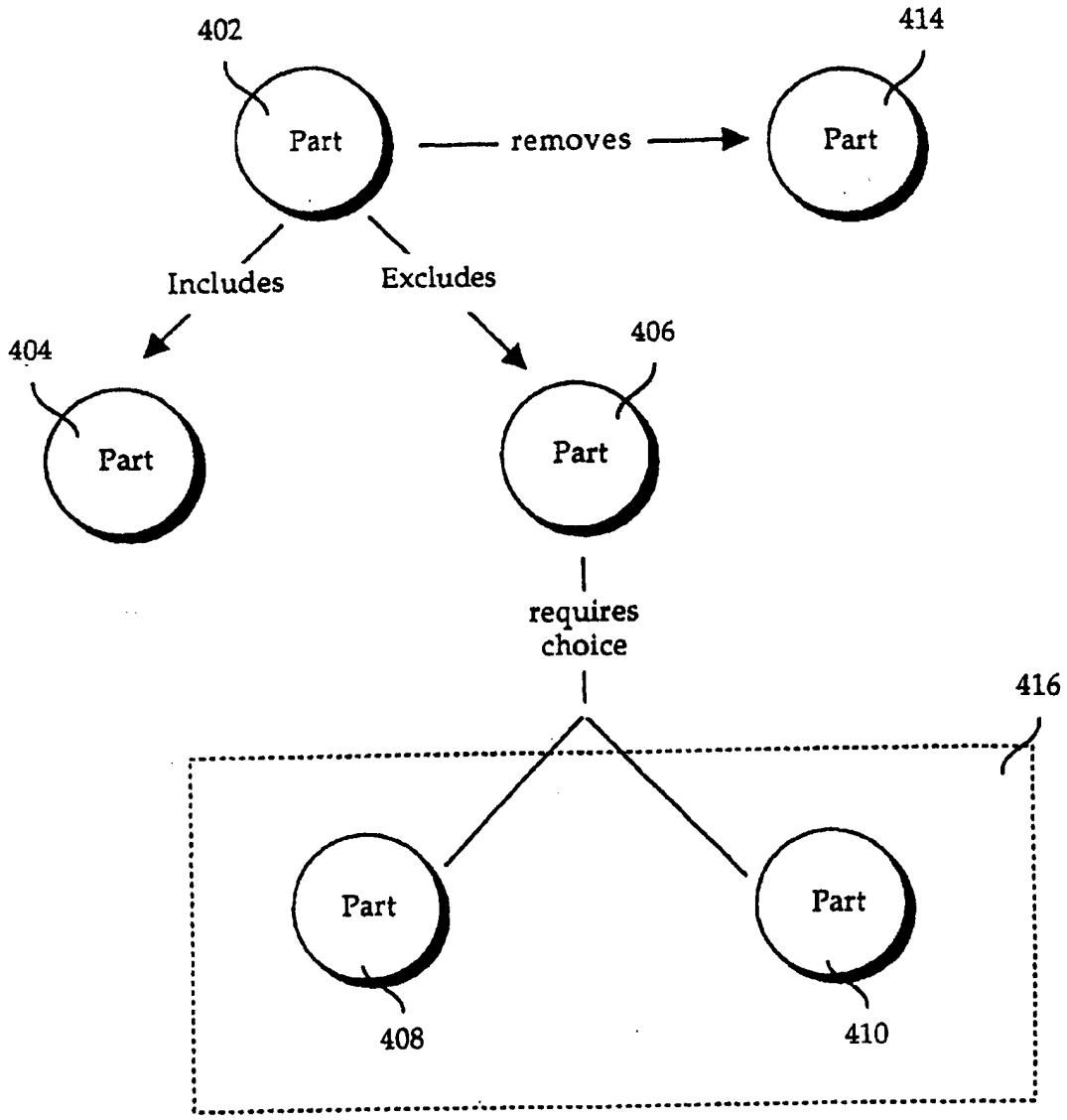
312
316
Group
Part
318
Part

FIG. 3


402
414
Part
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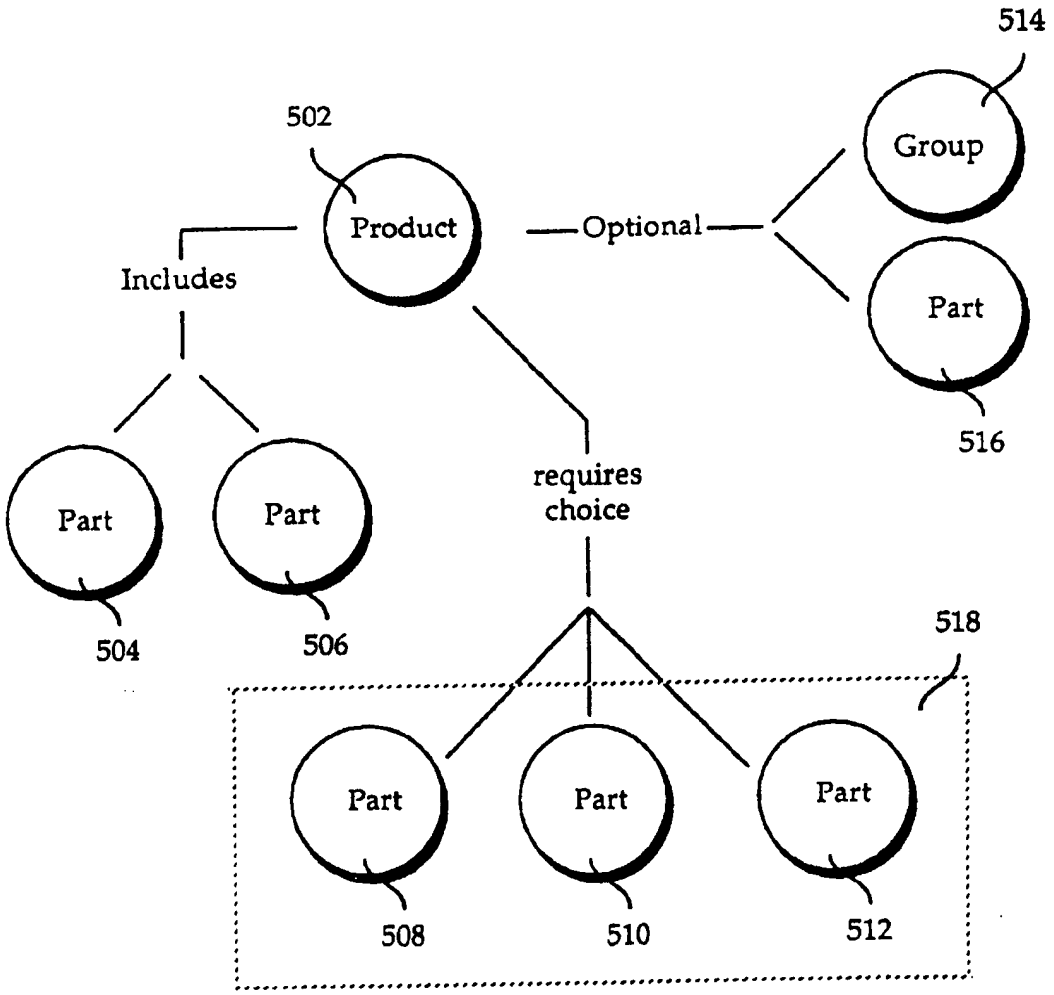
Includes
Excludes
404
406
Part
Part
requires
choice
416
Part
Part
408
410

FIG. 4


514
502
Group
Product
Optional
Includes
Part
516
Part
Part
requires
choice
504
506
518
Part
Part
Part
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510
512

FIG. 5

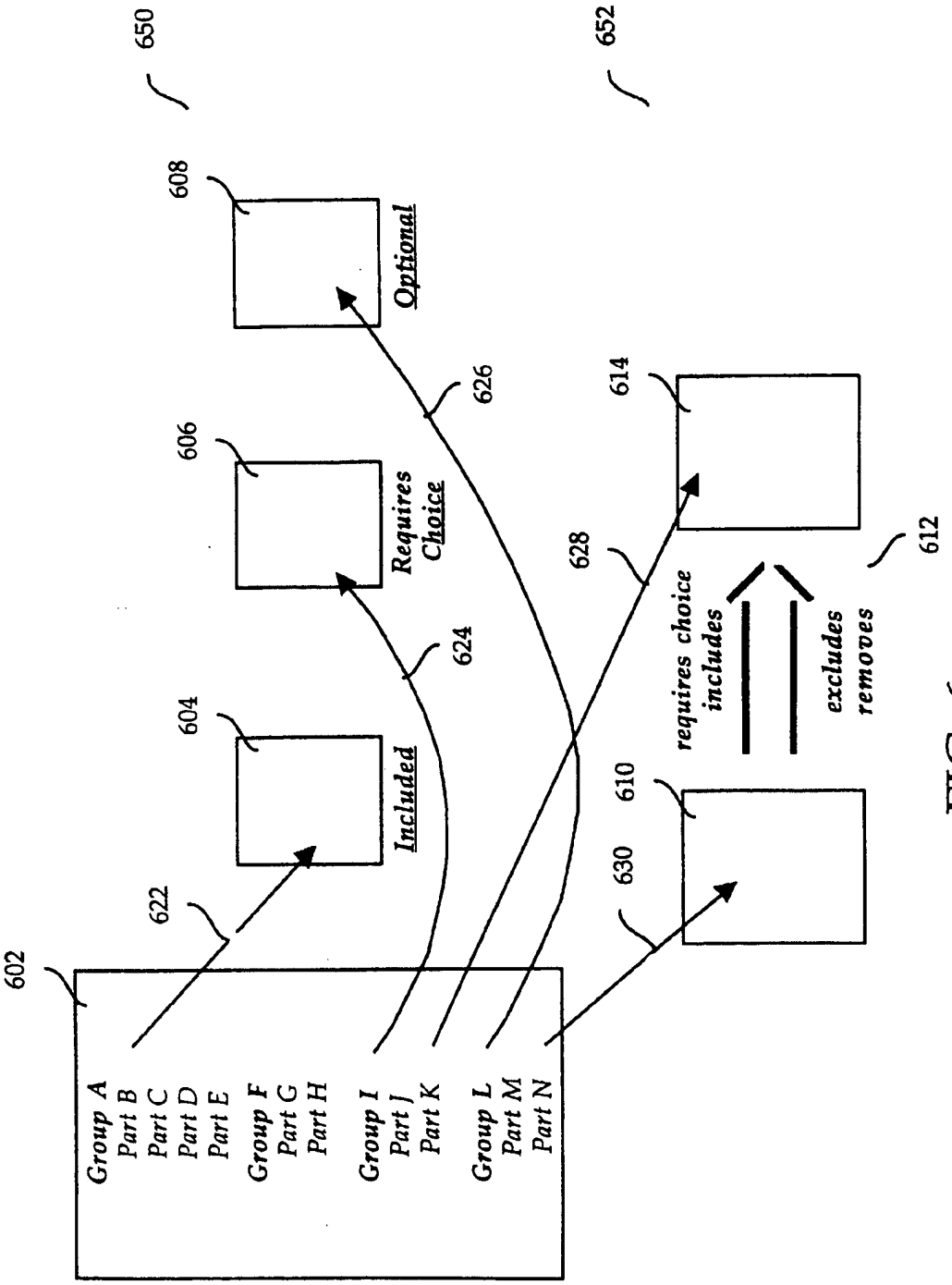
650
652
608
Optional
606
Requires Choice
604
Included
602
622
624
626
628
630
614
610
612
requires choice includes
excludes removes
Group A
Part B
Part C
Part D
Part E
Group F
Part G
Part H
Group I
Part J
Part K
Group L
Part M
Part N

FIG. 6

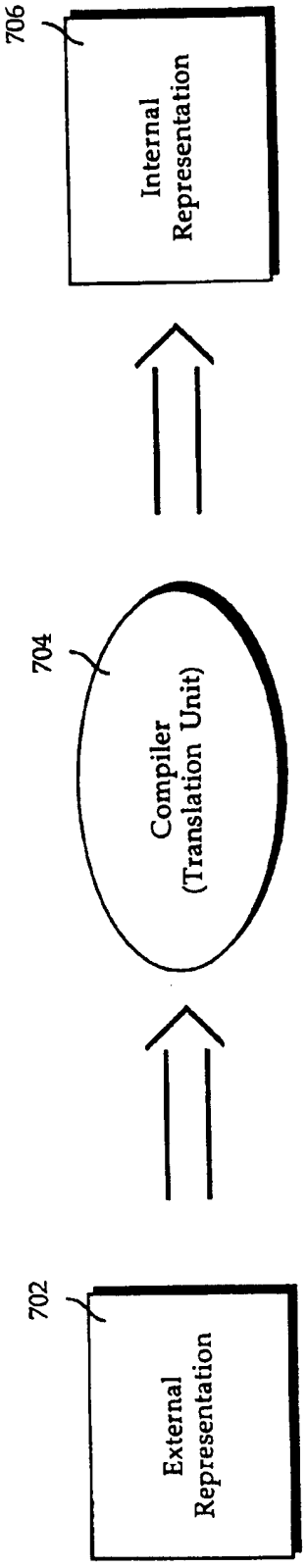
706
Internal Representation
704
Compiler (Translation Unit)
702
External Representation

Figure 7

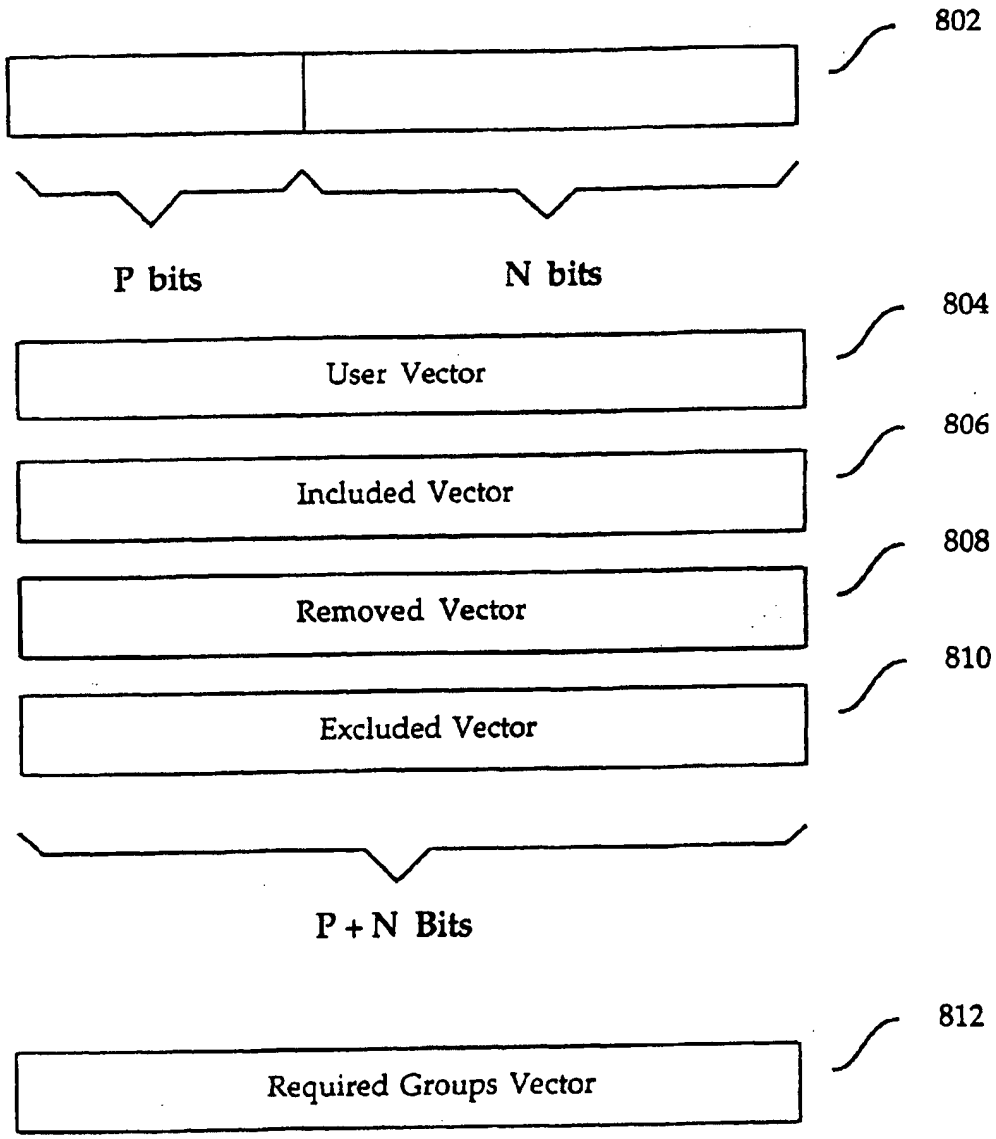
802
P bits
N bits
804
User Vector
806
Included Vector
808
Removed Vector
810
Excluded Vector
P + N Bits
812
Required Groups Vector

FIG. 8A

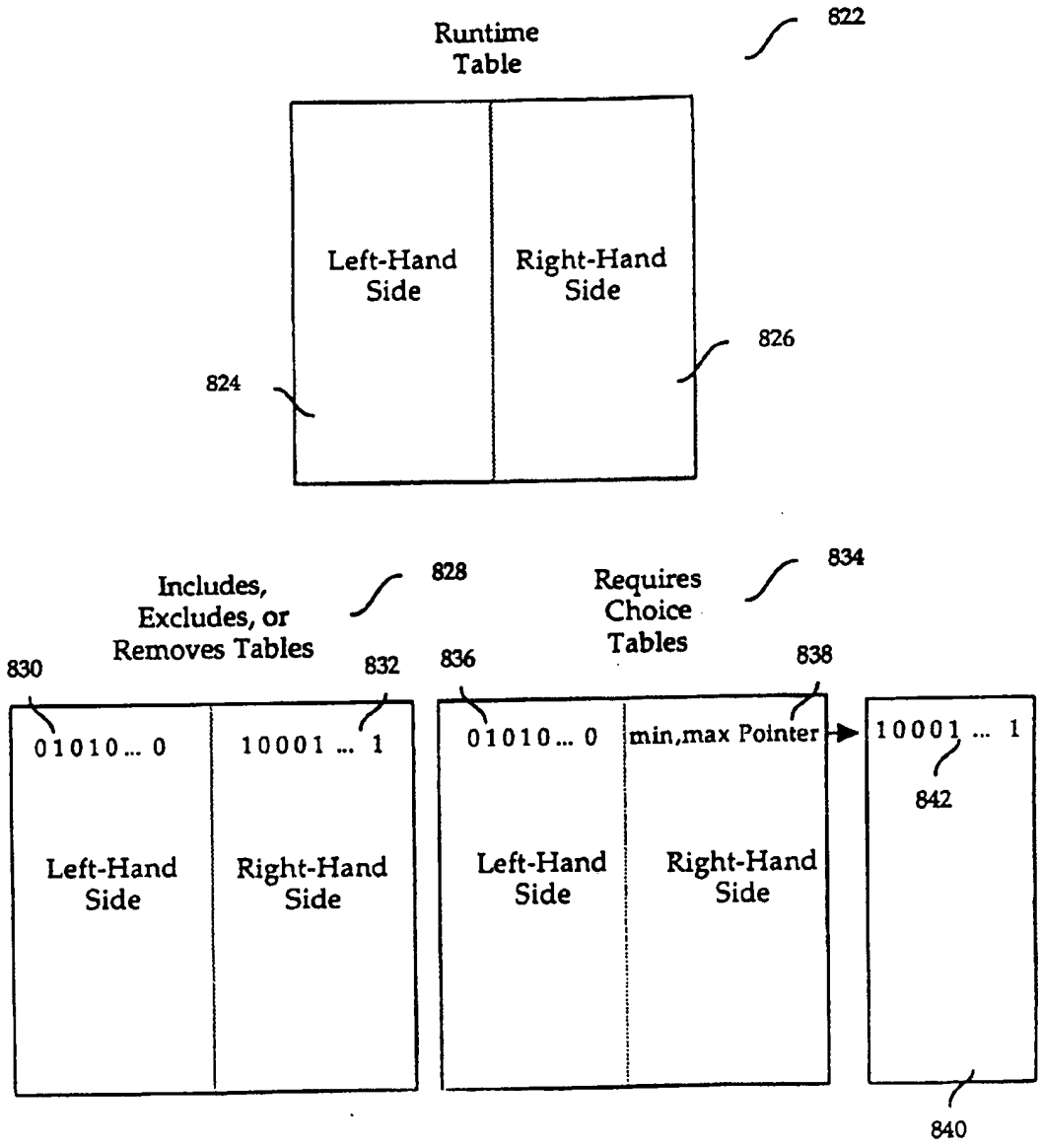
Runtime Table
822
Left-Hand Side
Right-Hand Side
824
826
Includes, Excludes, or Removes Tables
828
Requires Choice Tables
834
830
832
836
838
01010... 0
10001 ... 1
01010... 0
min,max Pointer
10001 ... 1
842
Left-Hand Side
Right-Hand Side
Left-Hand Side
Right-Hand Side
840

FIG. 8B

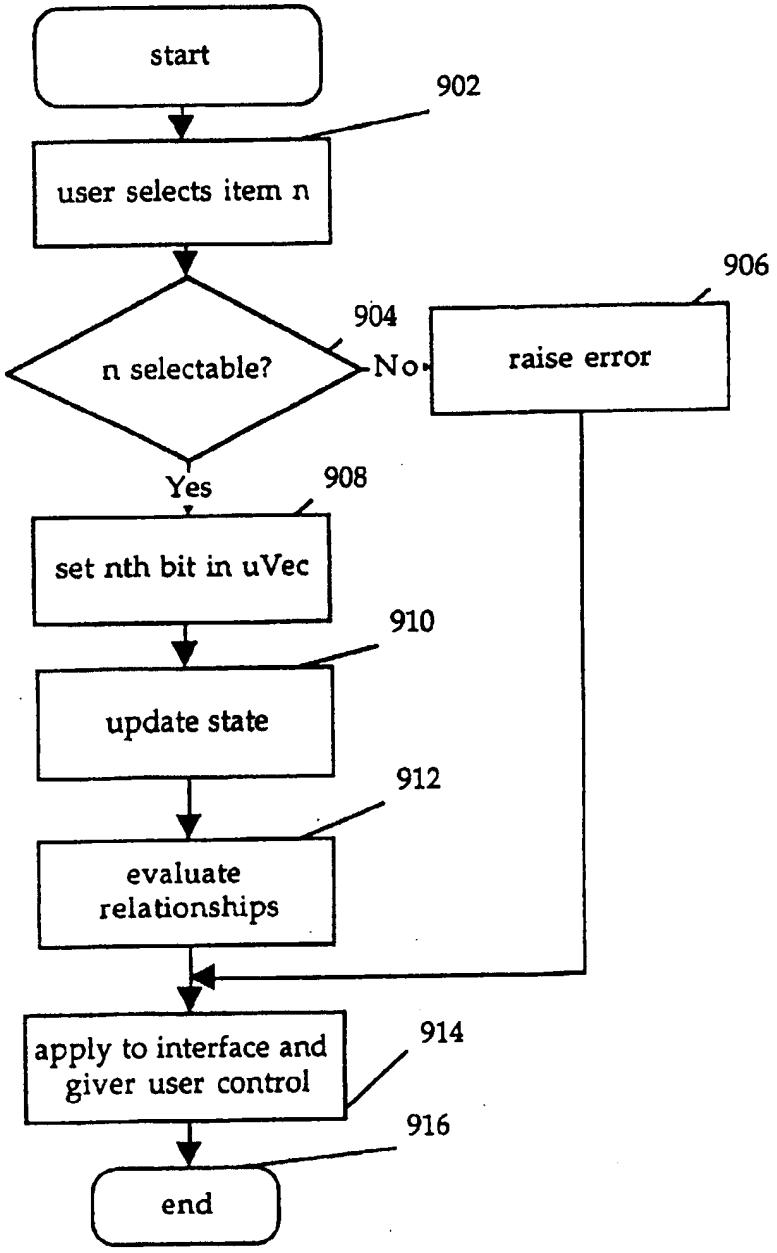
start
902
user selects item n
906
904
n selectable?
No
raise error
Yes
908
set nth bit in uVec
910
update state
912
evaluate relationships
914
apply to interface and giver user control
916
end

FIG. 9

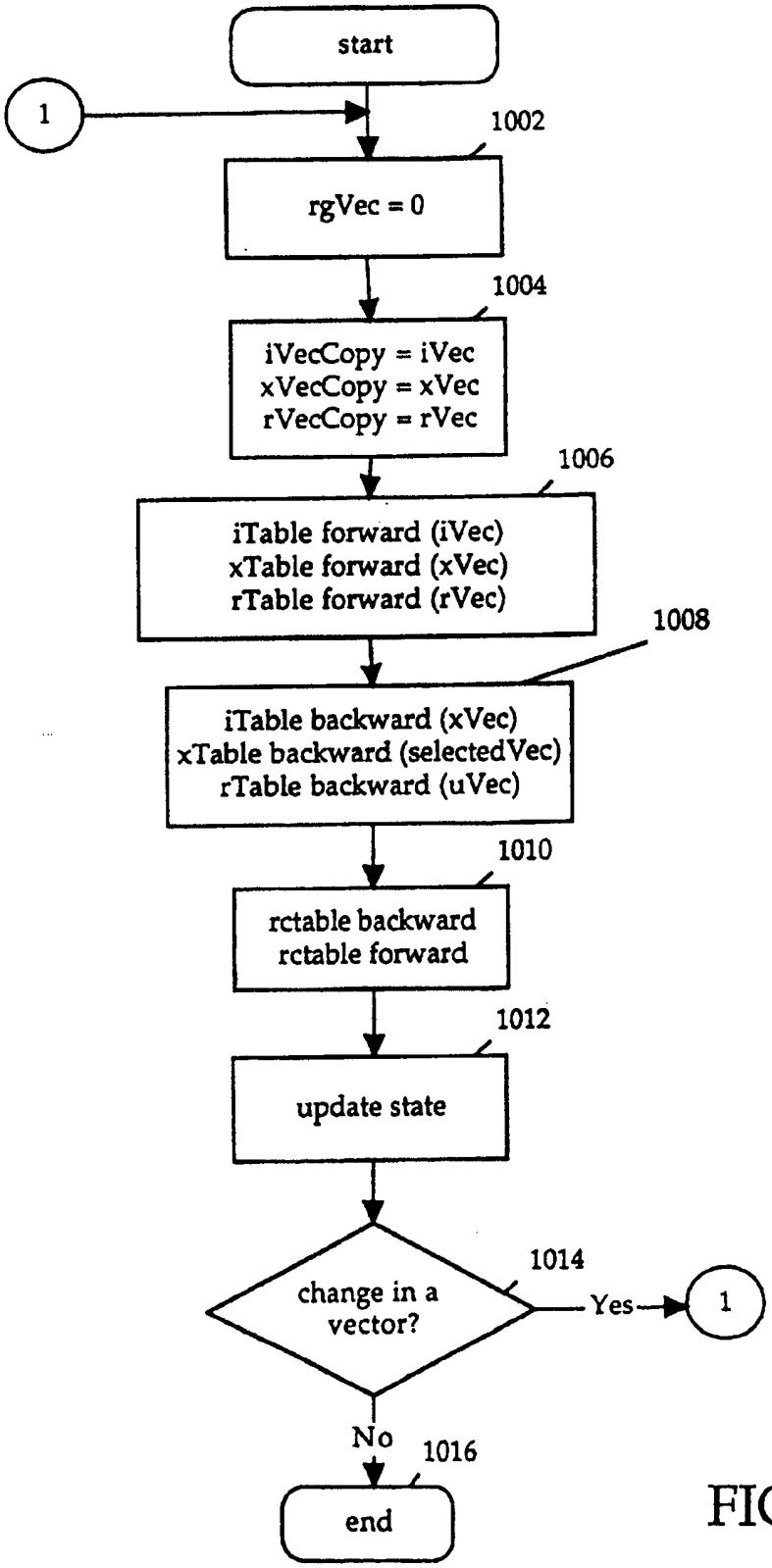
start
1
1002
rgVec = 0
1004
iVecCopy = iVec
xVecCopy = xVec
rVecCopy = rVec
1006
iTable forward (iVec)
xTable forward (xVec)
rTable forward (rVec)
1008
iTable backward (xVec)
xTable backward (selectedVec)
rTable backward (uVec)
1010
rctable backward
rctable forward
1012
update state
1014
change in a vector?
Yes
1
No
1016
end

FIG. 10

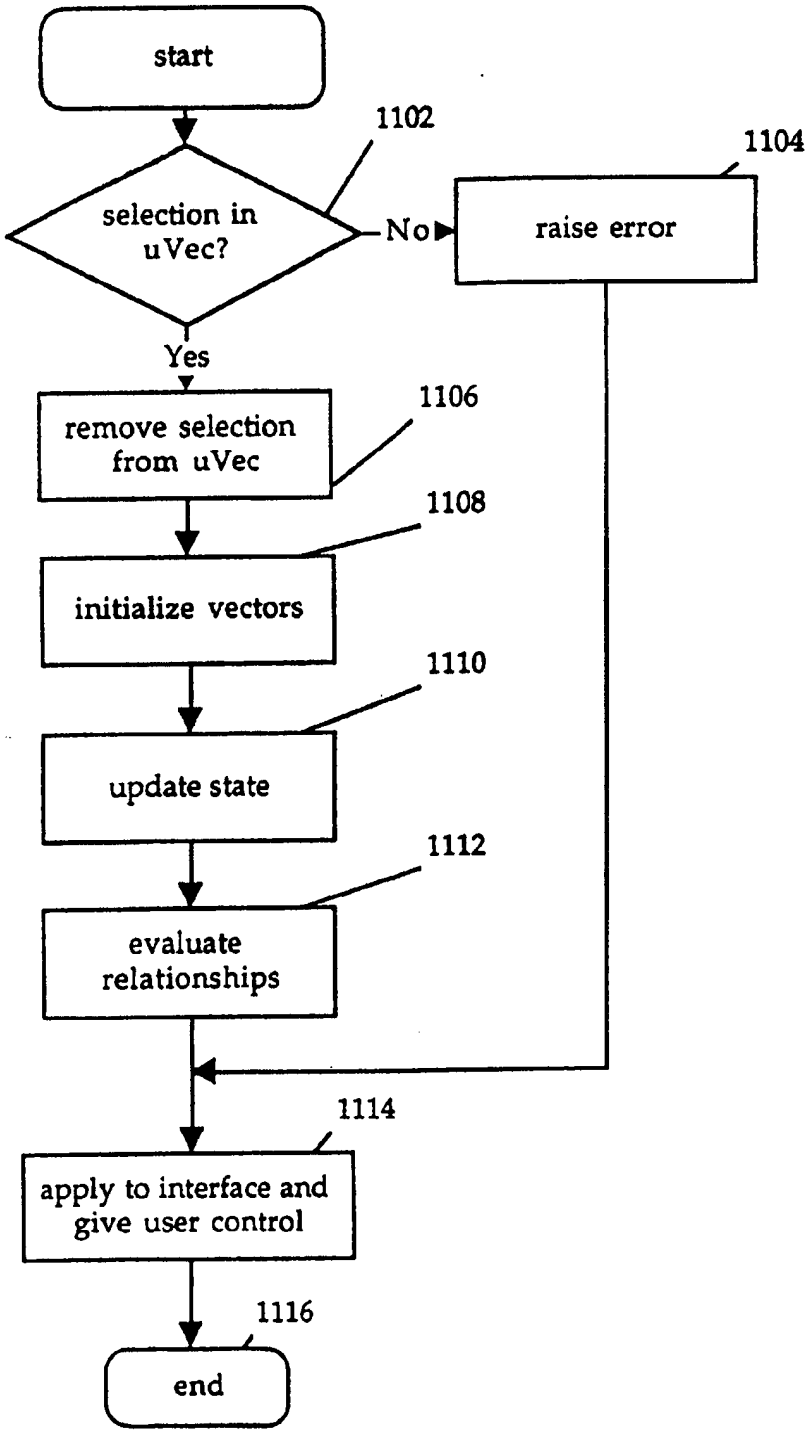
start
1102
selection in uVec?
No
1104
raise error
Yes
1106
remove selection from uVec
1108
initialize vectors
1110
update state
1112
evaluate relationships
1114
apply to interface and give user control
1116
end

FIG. 11

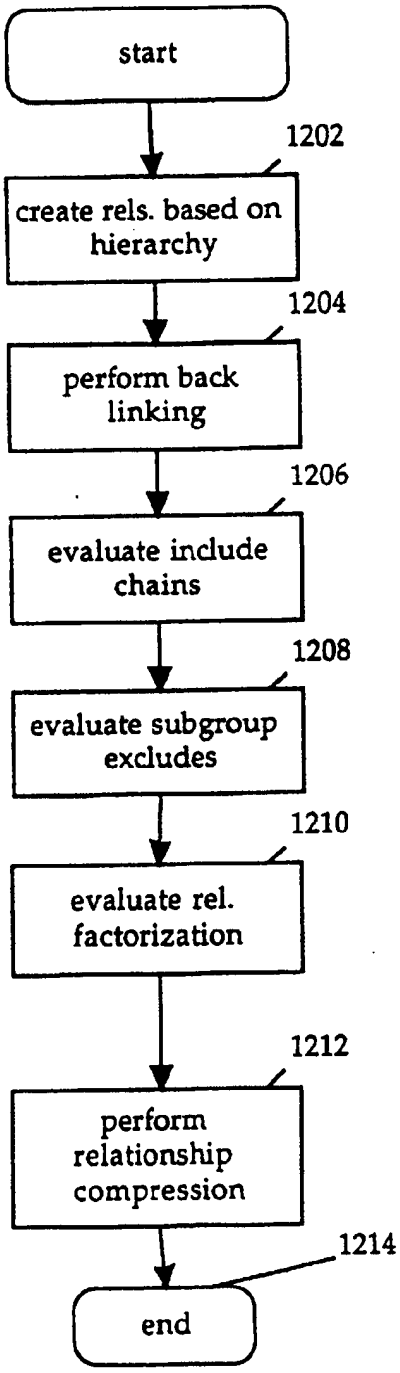
start
1202
create rels. based on hierarchy
1204
perform back linking
1206
evaluate include chains
1208
evaluate subgroup excludes
1210
evaluate rel. factorization
1212
perform relationship compression
1214
end

FIG. 12

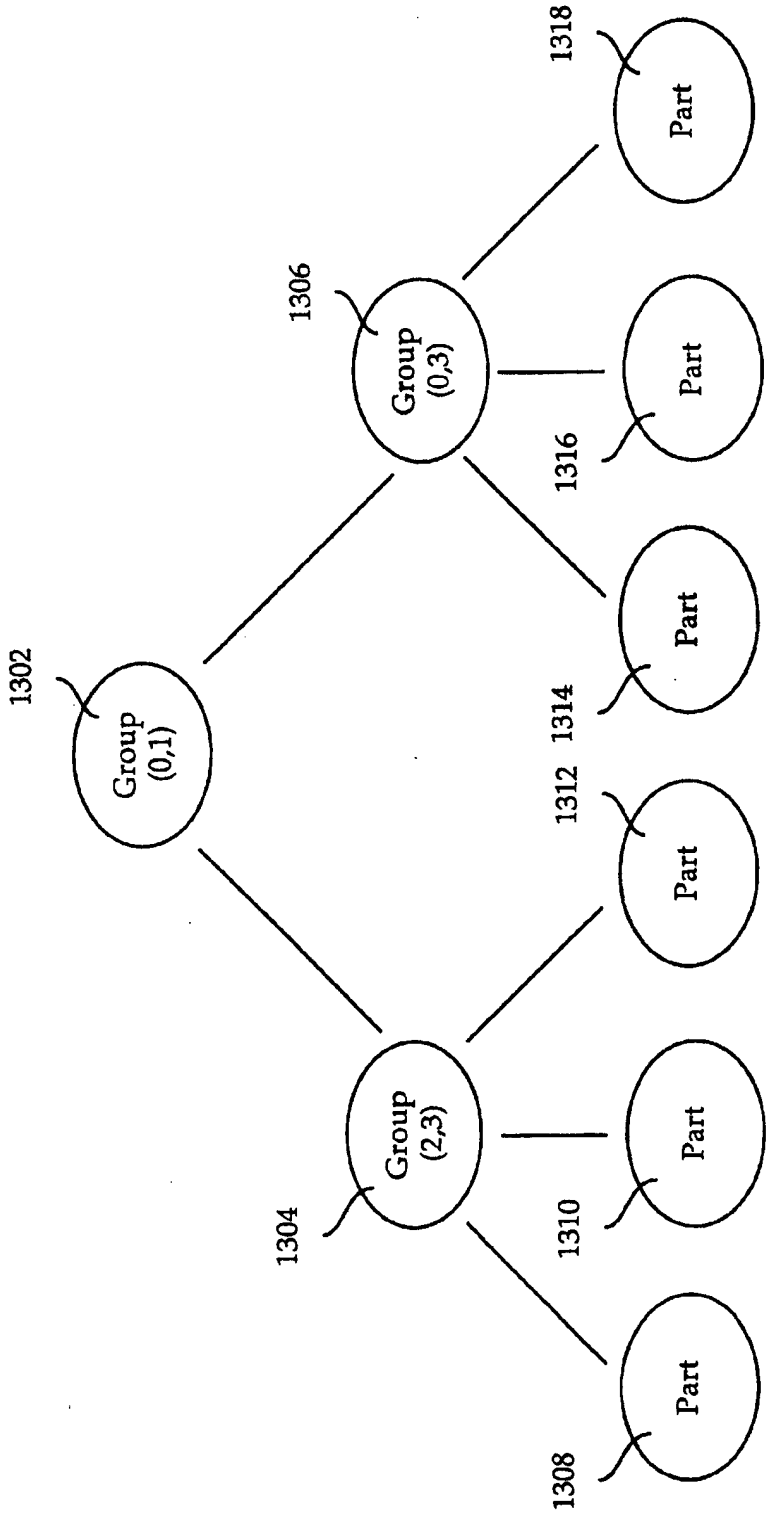
1302
Group (0,1)
1304
Group (2,3)
1306
Group (0,3)
1308
Part
1310
Part
1312
Part
1314
Part
1316
Part
1318
Part

FIG. 13A

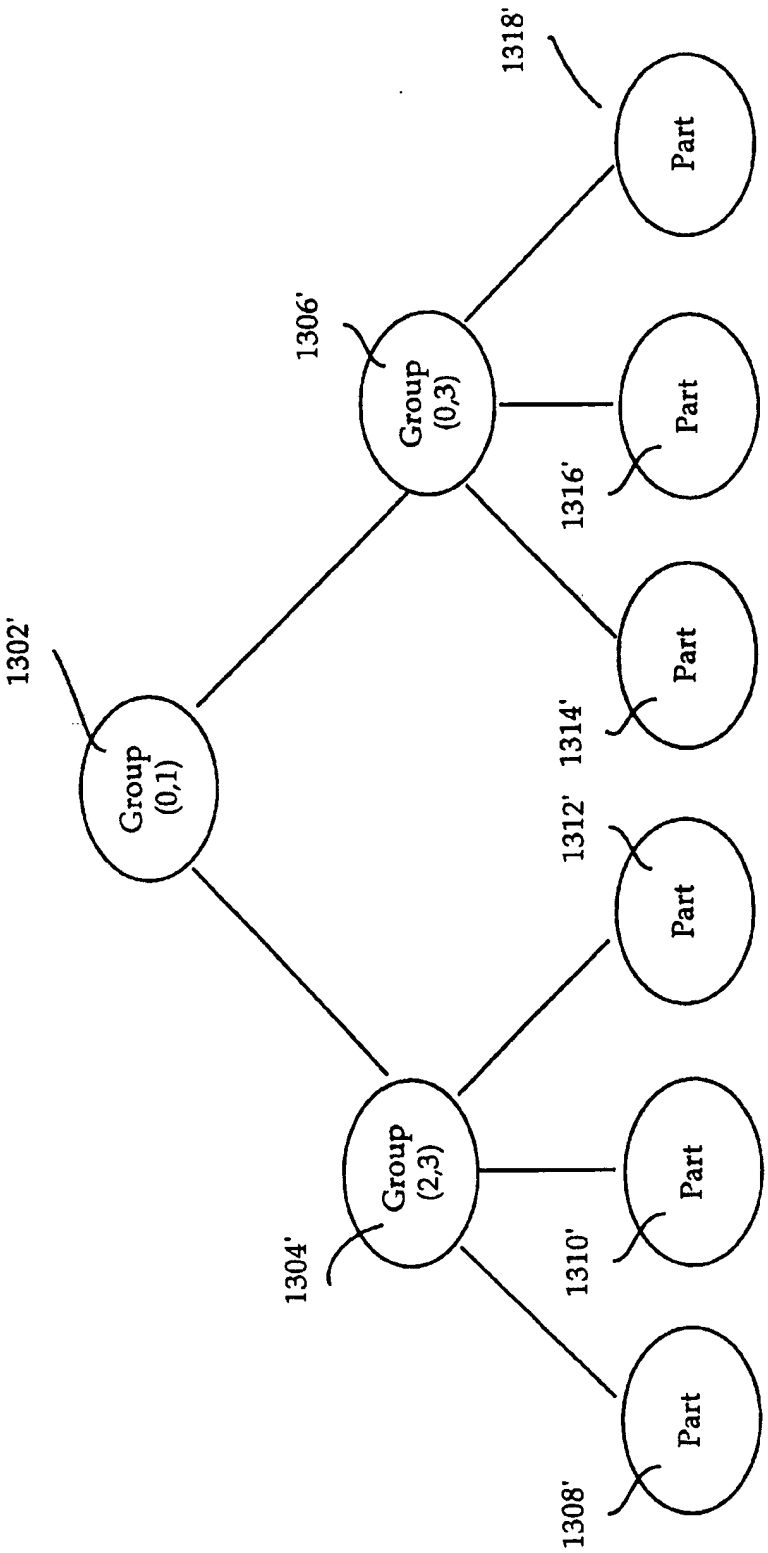
1318'
Part
1306'
Group (0,3)
Part
1316'
1302'
Group (0,1)
Part
1314'
1312'
Part
1304'
Group (2,3)
Part
1310'
Part
1308'

FIG. 13B

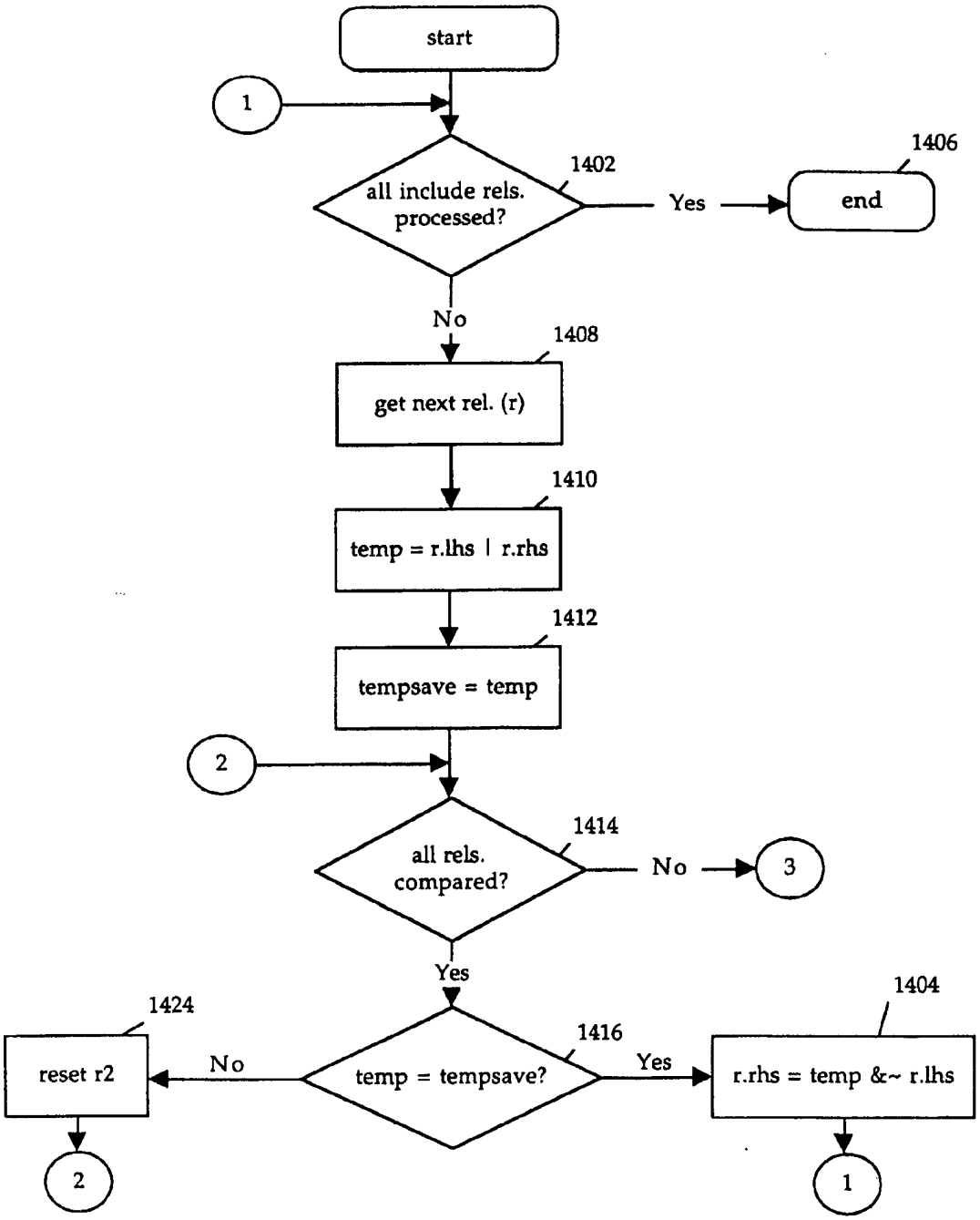
start
1
1402
all include rels. processed?
Yes
1406
end
No
1408
get next rel. (r)
1410
temp = r.lhs | r.rhs
1412
tempsave = temp
2
1414
all rels. compared?
No
3
Yes
1424
reset r2
No
1416
temp = tempsave?
Yes
1404
r.rhs = temp &~ r.lhs
2
1

Fig. 14A

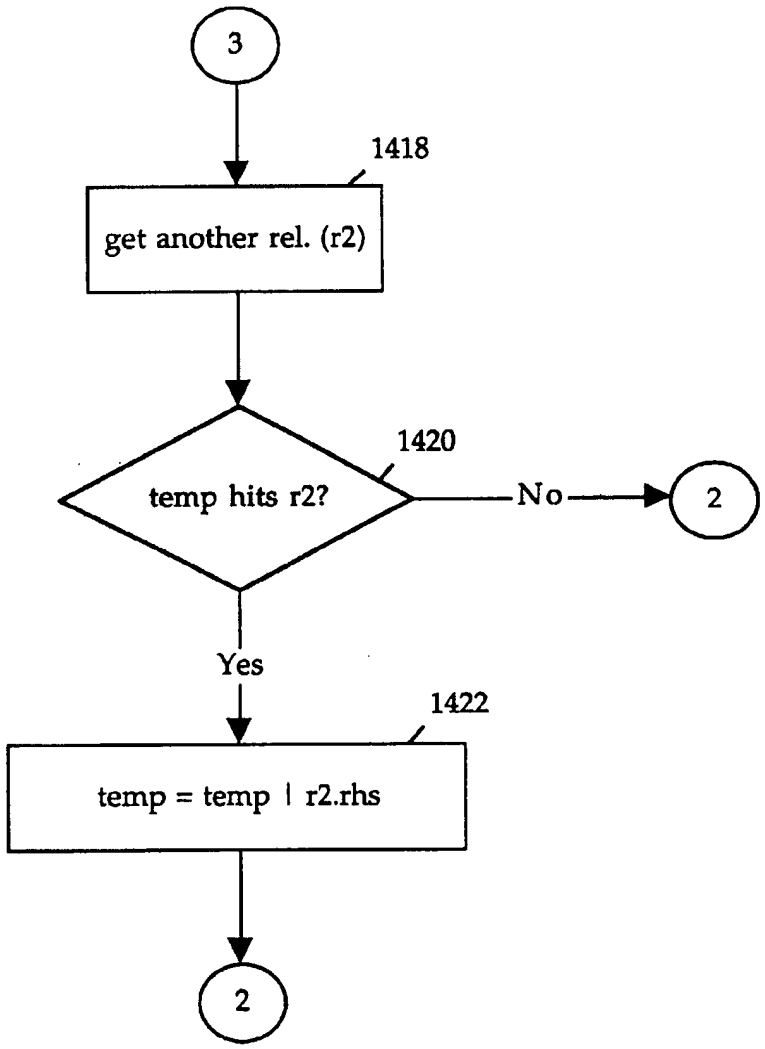
3
1418
get another rel. (r2)
1420
temp hits r2?
No
2
Yes
1422
temp = temp | r2.rhs
2

FIG. 14B

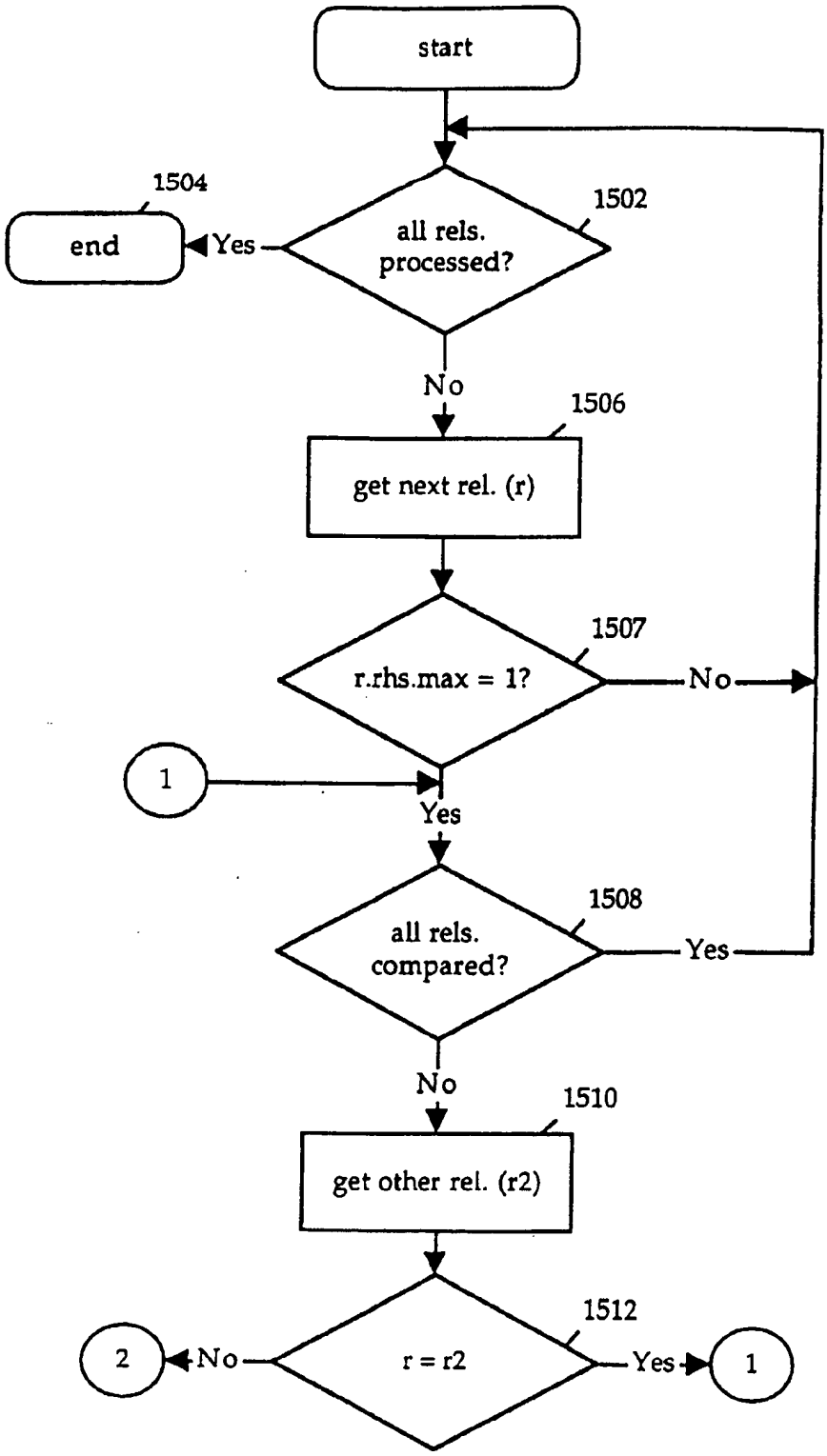
start
1504
end
Yes
1502
all rels. processed?
No
1506
get next rel. (r)
1507
r.rhs.max = 1?
No
1
Yes
1508
all rels. compared?
Yes
No
1510
get other rel. (r2)
1512
2
No
r = r2
Yes
1

FIG. 15A

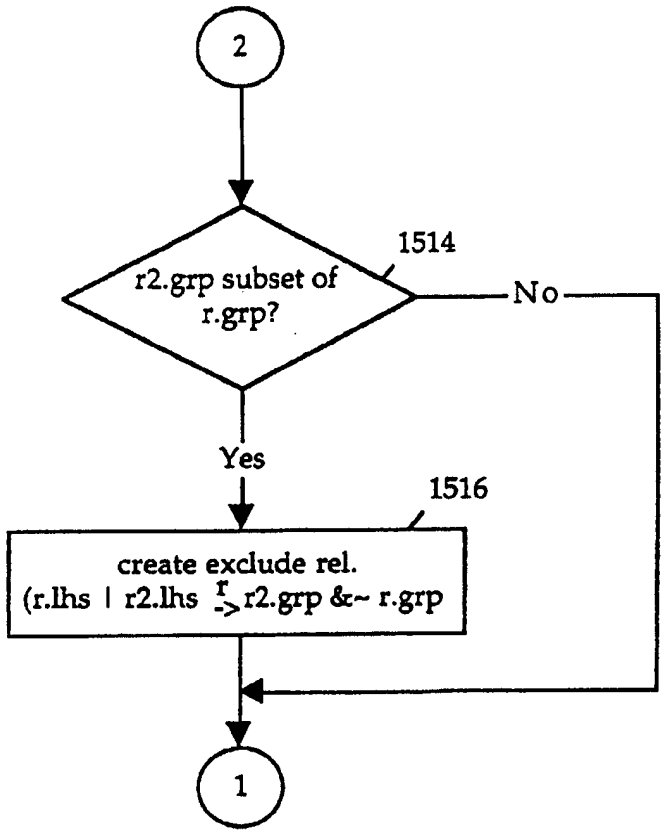
2
1514
r2.grp subset of r.grp?
No
Yes
1516
create exclude rel.
(r.lhs | r2.lhs r->r2.grp &~ r.grp
1

FIG. 15B

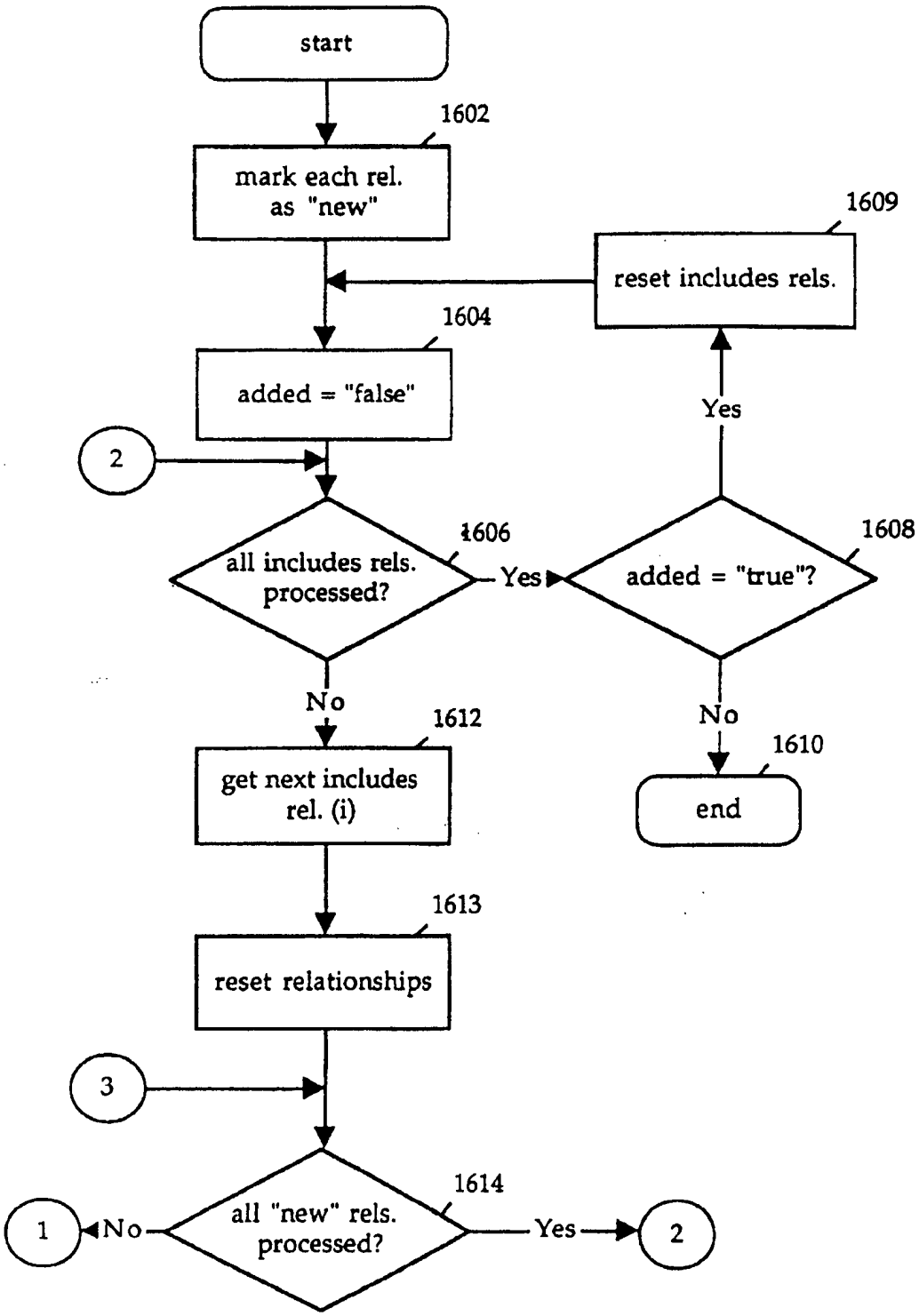
start
1602
mark each rel. as "new"
1609
reset includes rels.
1604
added = "false"
2
1606
all includes rels. processed?
Yes
1608
added = "true"?
Yes
No
No
1612
get next includes rel. (i)
1610
end
1613
reset relationships
3
1614
all "new" rels. processed?
1
No
Yes
2

FIG. 16A

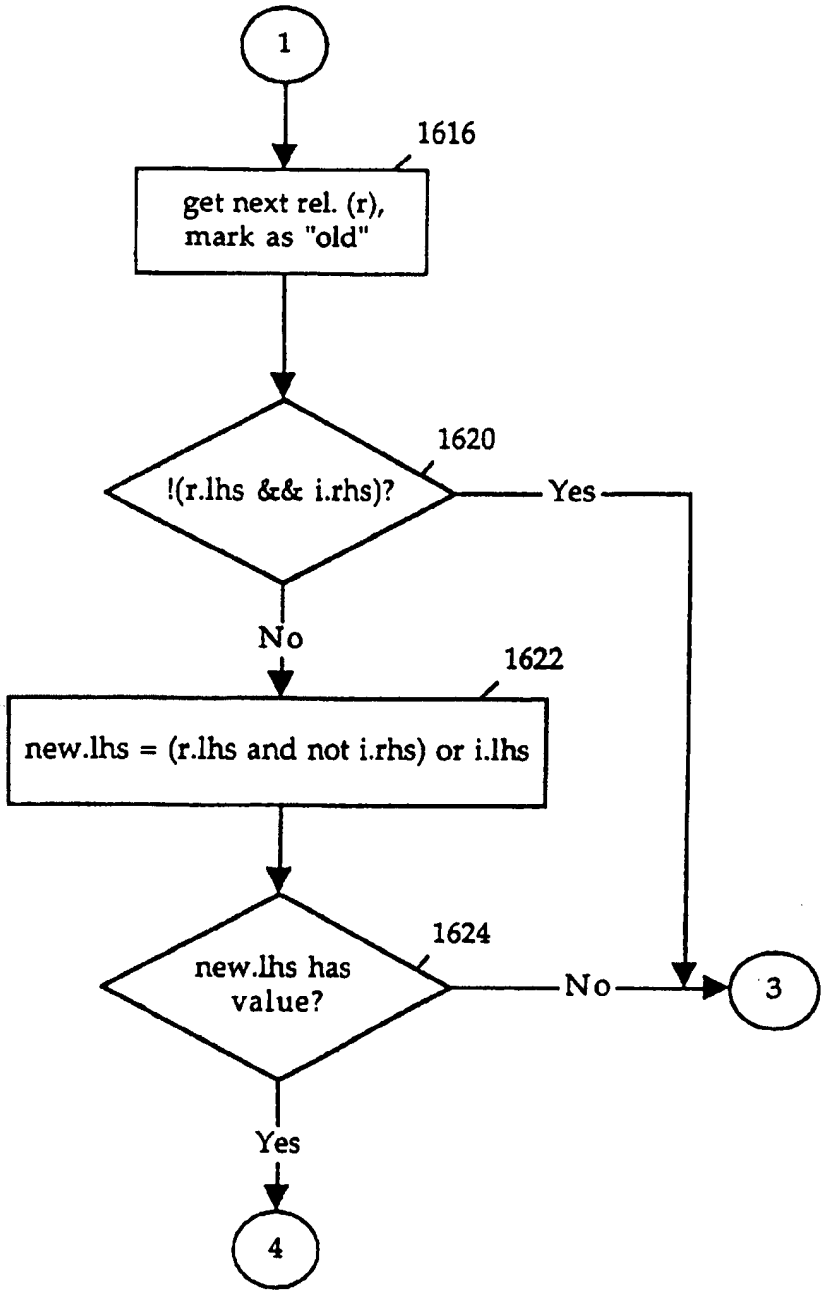
1
1616
get next rel. (r), mark as "old"
1620
!(r.lhs && i.rhs)?
Yes
No
1622
new.lhs = (r.lhs and not i.rhs) or i.lhs
1624
new.lhs has value?
No
3
Yes
4

FIG. 16B

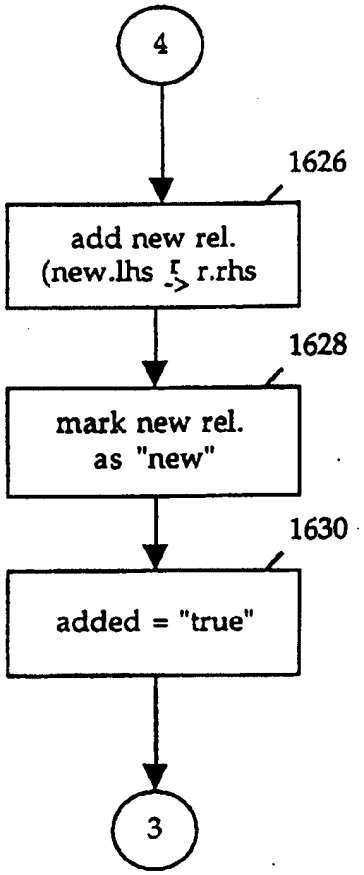
4
1626
add new rel.
(new.lhs -> r.rhs
1628
mark new rel.
as "new"
1630
added = "true"
3

FIG. 16C

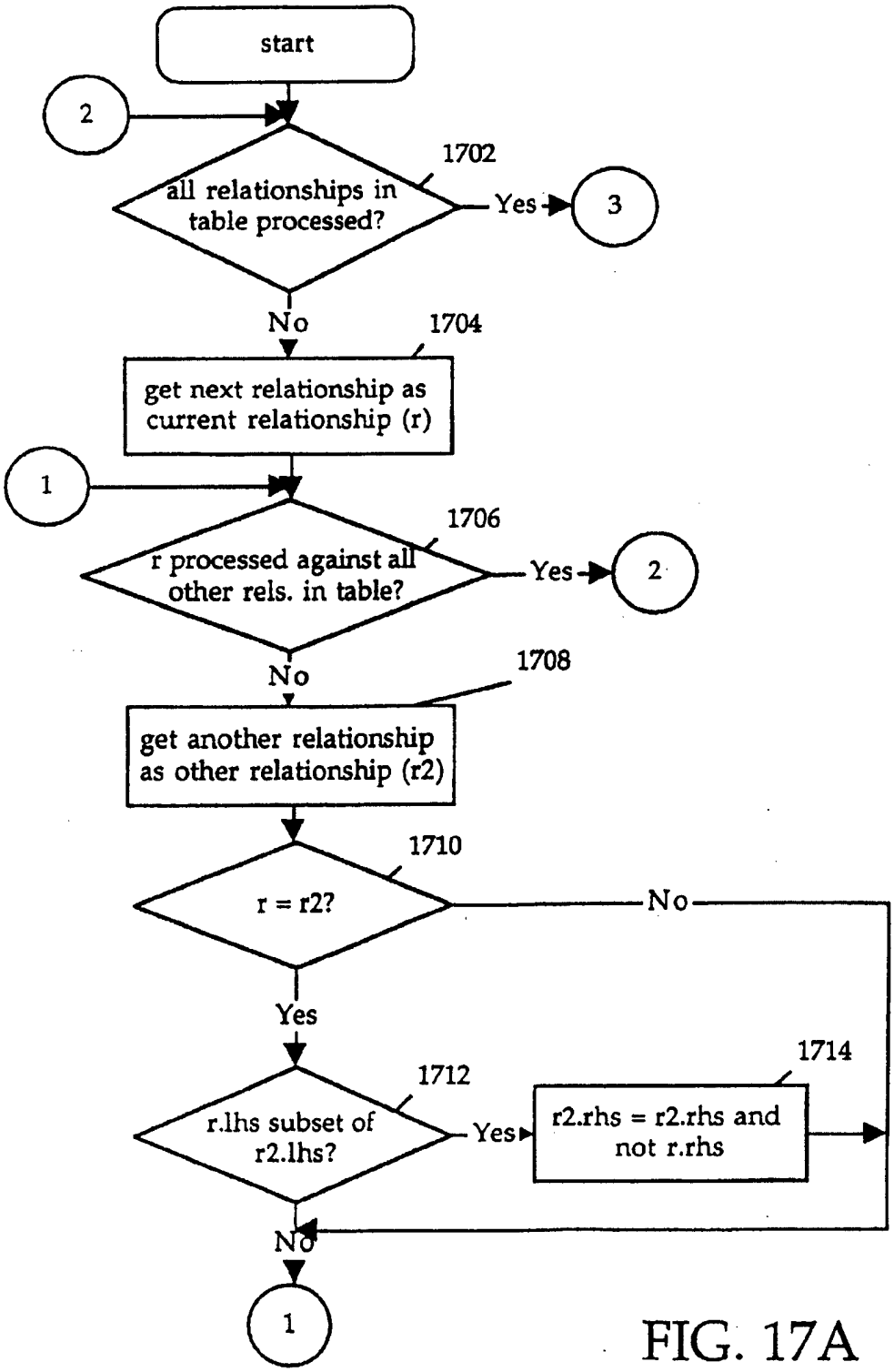
start
2
1702
all relationships in table processed?
Yes
3
No
1704
get next relationship as current relationship (r)
1
1706
r processed against all other rels. in table?
Yes
2
No
1708
get another relationship as other relationship (r2)
1710
r = r2?
No
Yes
1714
1712
r.lhs subset of r2.lhs?
Yes
r2.rhs = r2.rhs and not r.rhs
No
1

FIG. 17A

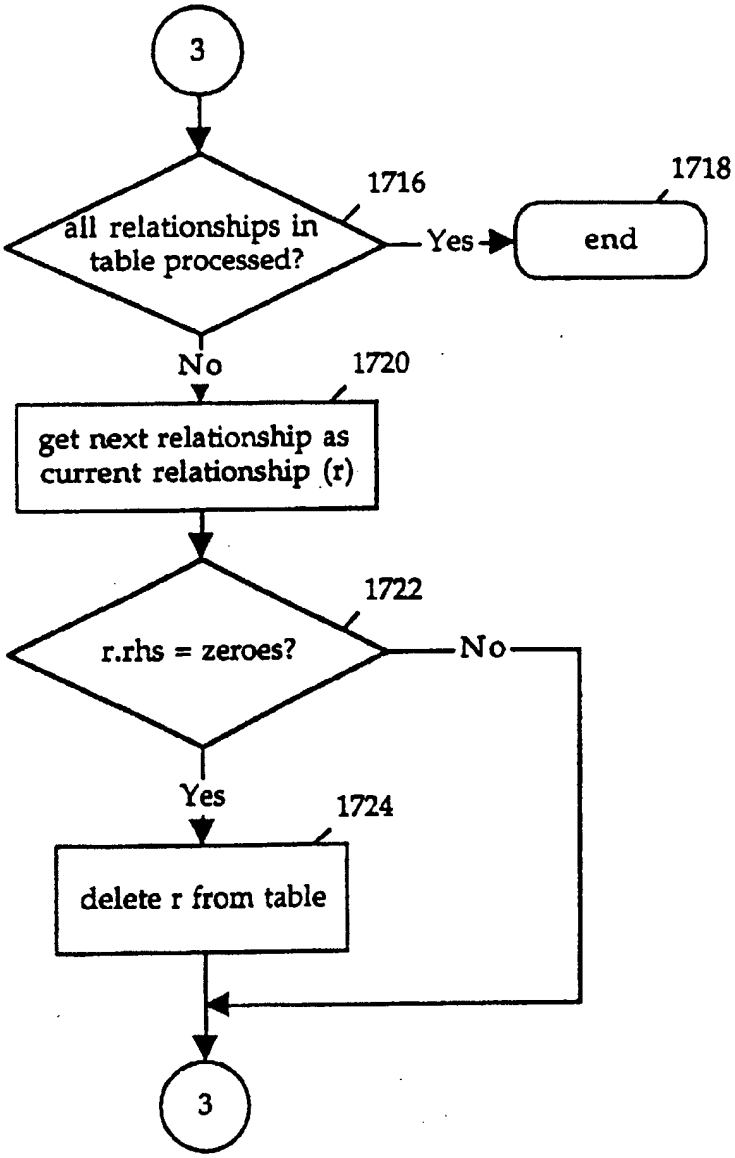
3
1716
all relationships in table processed?
Yes
1718
end
No
1720
get next relationship as current relationship (r)
1722
r.rhs = zeroes?
No
Yes
1724
delete r from table
3

FIG. 17B

METHOD AND APPARATUS FOR MAINTAINING AND CONFIGURING SYSTEMS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to maintaining and configuring systems.

2. Background Art

A system is comprised of components. Before a system can be built the components of the system must be identified. To configure a system, a user must select the parts to include in the system. Typically, one who is knowledgeable about a system and its components defines the system. Thus, for example, an automobile salesperson assists an automobile buyer in determining the type and features of the automobile. The salesperson understands the features and options that are available to create a valid configuration. Some features and options cannot be combined. The selection of some features caused other features to be unavailable, etc. It would otherwise be difficult for the buyer to identify all of the features and options available on the automobile that can be combined to create a valid configuration.

Computer systems have been developed to assist one in configuring a system. However, these systems use a configuration language to define a system. Like a programming language, a configuration language uses a syntax that must be understood by a user who is maintaining the data (i.e., a data maintainer). To use one of these configuration systems, it is necessary for a data maintainer to understand the configuration language. This limits the number of users who are able to use the configuration systems. That is, the level of sophistication needed to communicate with the configuration system (through a configuration language) results in less sophisticated users being unable to use the system.

In addition, configuration systems impose a flow or ordering to the user operations. For example, a user is required to remove components from the system in reverse of the order in which they were chosen. Thus, a user may be forced to remove components that the user wants to keep in the configuration to remove an unwanted component. A novice user may have perform many removal operations before achieving an acceptable configuration. If the novice user is required to remove components in a preset order, the user can become frustrated or confused and abort the configuration process.

These systems are designed for a more sophisticated user that has knowledge of the system that is being configured as well as the configuration system used to configure the system. A end user such as an automobile shopper would have difficulty using these systems.

Further, to use these systems a user must be trained to understand the configuration language. Thus, a user who otherwise has knowledge of the systems that are being configured must undergo training to be able to use these configuration systems to configure systems. This leads to increased expenditures such as for training.

SUMMARY OF THE INVENTION

The invention provides the ability to interactively select and configure a product among a set of related products based on availability and compatibility of features and options. It does not impose an order in the selection of products, features or options; only valid selections can be made at any time. To create an electronic representation of the product information to achieve the above goal, the invention provides a framework for defining a product line.

A product line is defined as a set of related products. A product line has a set of products that contain parts, or components. Parts used to define a product are selected from a parts catalog. Parts in a product definition are related or classified as: included (parts that are included by default), required choices (a choice among a group of parts that must be made to achieve a valid configuration), optional (parts that can be optionally included in the configuration).

Relationships can be defined between the parts in a product definition. A relationship relates a first set of parts with a second set of parts. A set can include multiple parts. The incorporation of parts in a set can be arbitrary. That is, a multi-part set can contain parts that are otherwise unrelated. For example, a set can contain parts such as an engine, sun roof and a color. These parts seem to be unrelated, however, it is possible to combine them into a relationship set for purposes of forming a relationship using the present invention.

Preferably, the part relationships are: included, excluded, removed, and requires choice. An included part is included automatically. A part is excluded from the configuration when its inclusion would result in an invalid configuration. A part may be removed when another part is added. Thus, when a first part exists in the configuration and a second part is added, the first part is removed from the configuration. The requires choice relationship is used to allow a set of choices to be made from a group of parts. The number of parts chosen is limited to a valid bounds specification. The relations that are created between parts within a product are enforced only on that particular product. However, if some part-to-part relationships are to be enforced on all products within a product line, then the relations are generated once and enforced for all products.

A maintenance system is used to define a product. Using the maintenance system, a product can be defined using the product classifications and the part relationships. A graphical user interface (GUI) is used to allow the user to interactively generate a definition. Instead of configuration languages, GUI operations such as drag and drop and selection operations can be used to specify a definition. The notions of included, optional and required choice are easily comprehensible to a user. Further, the idea that parts have interrelationships is also easily understood. Thus, a product can be defined without having to learn a complicated configuration language.

A configuration system is used to configure a system using a definition created by the maintenance system. The configuration system ensures that the current configuration state is always valid. The user can select and unselect parts in any order. When user input is received, the configuration system validates the input based on the current state of the configuration. In addition, the configuration system identifies selections that could cause a valid configuration to become invalid. The configuration removes these selections from the set of possible selections so that the user does not make an invalid selection.

The configuration system evaluates the current state of a configuration based on the product definition, part relationships and state information. After receipt of input from a user, the configuration system evaluates relationships in both the forward and backward direction. Forward and backward evaluations can result in the addition or deletion of elements from the configuration.

The invention uses both an external and internal representation of a definition or definitions. A translation mechanism is used translate an external representation into an internal representation. The external representation uses a conceptually understandable set of relationships for defining a system and the relationships between the components of the system. The invention takes the definition created by a user and supplements and compresses the definition when necessary to create an internal representation. The internal representation is used during configuration to initialize and validate a configuration based on user input.

During configuration, the invention maintains runtime information that is stored in tables and vectors. To achieve greater processing efficiency, the systems represents elements in a configuration (e.g., product, part, and group) as a bit in a bit vector. Thus, for example, a vector has a length that is equal to the total number of elements. An element's bit can be set or reset to specify the state of the element in the current configuration. For example, a user vector can be used that specifies for each element whether the element has been selected by the user during the configuration. In addition, excluded and removed vectors identify whether an element is excluded or removed (respectively) from a configuration. Vectors can be used to identify whether an element 1) has been selected (by the user or the configuration system), 2) is selectable, and 3) notSelectable.

Tables contain element relationships. A table is used to represent the includes, excludes, removes, and requires choice relationships, for example. Each table has a left-hand side and a right-hand side that corresponds to the left-hand and right-hand sides of a relationship. In each case, the left-hand side is a bit vector that contains bits that correspond to elements. The includes, excludes and removes tables contain a bit vector in the right-hand side that represents configuration elements. The right-hand side of the requires choice table is a pointer that points to an entry in a group table. The group table entry is a bit vector that identifies the elements that are contained in the group from which a choice is to be made. The right-hand side of a requires choice table entry further includes minimum and maximum designations. Minimum and maximum values identify the minimum and maximum number of group members that are to be selected to satisfy a requires group relationship.

A bit vector implementation of relationships and internal runtime state allows for fast and efficient computation of relationship based configuration. A comparison of bits can be performed in one machine instruction in most cases.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** provides an illustration of a computer system that can be used with the invention according to an embodiment of the invention.

FIG. **2** provides an overview of the maintenance and configuration systems according to an embodiment of the invention.

FIG. **3** illustrates examples of elements in a parts catalog according to an embodiment of the invention.

FIG. **4** illustrates relationships between parts according to an embodiment of the invention.

FIG. **5** provides an example of product classifications according to an embodiment of the invention.

FIG. **6** provides an example of a GUI screen used in maintenance system **202** according to an embodiment of the present invention.

FIG. **7** provides an block diagram illustrating the conversion process according to one embodiment of the invention.

FIGS. **8A–8B** illustrate components of internal representation **706** according to an embodiment of the invention.

FIG. **9** provides a process flow for processing a user selection according to an embodiment of the invention.

FIG. **10** provides an example of a relationship evaluation process flow according to an embodiment of the invention.

FIG. **11** provides an example of an unselect item process flow according to an embodiment of the invention.

FIG. **12** provides a flow for translation processing according to an embodiment of the invention.

FIGS. **13A–13B** provide an illustration of groups and nested groups according to an embodiment of the invention.

FIGS. **14A–14B** provide an includes chain process flow according to an embodiment of the invention.

FIGS. **15A–15B** provides an example of a subgroup excludes process flow according to an embodiment of the invention.

FIGS. **16A–16C** provide an example of a relationship factorization process flow according to an embodiment of the invention.

FIGS. **17A–17B** provide an illustration of a relationship compression process flow according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

A method and apparatus for maintaining and configuring systems is described. In the following description, numerous specific details are set forth in order to provide a more thorough description of the present invention. It will be apparent, however, to one skilled in the art, that the present invention may be practiced without these specific details. In other instances, well-known features have not been described in detail so as not to obscure the invention.

The present invention can be implemented on a general purpose computer such as illustrated in FIG. **1**. A keyboard **110** and mouse **111** are coupled to a bidirectional system bus **118**. The keyboard and mouse are for introducing user input to the computer system and communicating that user input to CPU **113**. The computer system of FIG. **1** also includes a video memory **114**, main memory **115** and mass storage **112**, all coupled to bi-directional system bus **118** along with keyboard **110**, mouse **111** and CPU **113**. The mass storage **112** may include both fixed and removable media, such as magnetic, optical or magnetic optical storage systems or any other available mass storage technology. Bus **118** may contain, for example, **32** address lines for addressing video memory **114** or main memory **115**. The system bus **118** also includes, for example, a 32-bit DATA bus for transferring DATA between and among the components, such as CPU **113**, main memory **115**, video memory **114** and mass storage **112**. Alternatively, multiplex DATA/address lines may be used instead of separate DATA and address lines.

In the preferred embodiment of this invention, the CPU **113** is a 32-bit microprocessor manufactured by Motorola, such as the 680X0 processor or a microprocessor manufactured by Intel, such as the 80X86, or Pentium processor. However, any other suitable microprocessor or microcomputer may be utilized. Main memory **115** is comprised of dynamic random access memory (DRAM). Video memory **114** is a dual-ported video random access memory. One port of the video memory **114** is coupled to video amplifier **116**. The video amplifier **116** is used to drive the cathode ray tube

(CRT) raster monitor **117**. Video amplifier **116** is well known in the art and may be implemented by any suitable means. This circuitry converts pixel DATA stored in video memory **114** to a raster signal suitable for use by monitor **117**. Monitor **117** is a type of monitor suitable for displaying graphic images.

The computer system described above is for purposes of example only. The present invention may be implemented in any type of computer system or programming or processing environment.

The invention maintains and configures systems. The invention eliminates the need for a user to learn a configuration language or write code to maintain and/or configure a system. A user interface uses various operations such as drag and drop and item selection to define a product, for example. Elements that comprise a definition (e.g., of a product) can be added or removed in any order. No order is imposed on the user. There is no requirement, for example, that the user remove parts of a product in the order in which they were added. No fixed flow or order is required to edit a given product.

A definition includes an identification of the components that comprise the definition and the interrelationships between the components. The interrelationships are conceptually easy for the user to understand. The same relationships are used to define and configure any system. An external representation that includes these relationships allows a user to view and maintain the definition. The external representation is translated into an internal representation that is designed to decrease processing time and increase response time.

In addition, during a configuration session, the invention is capable of allowing a user to select or unselect configuration items without imposing a flow on the user. There is no order imposed on the user in terms of the sequence in which items are selected for the configuration or unselected from the configuration. For example, it is not necessary to select a product before choosing options. The invention can identify the products that are still available based on the options that have already been selected. Further, a user can unselect an item (e.g., delete the item from the configuration) without regard to the order in which it was selected (e.g., added to the configuration).

Examples of systems that can be maintained or configured using the invention include automobiles, computers, time clock machines, and shoes. Terms such as part, product line, parts catalog, and product are used herein for illustration purposes. It should be apparent that this invention can be used to configure systems that are not limited to products and product lines, etc.

FIG. **2** provides an overview of the maintenance and configuration systems according to an embodiment of the invention. Maintenance system **202** maintains a parts catalog **204**, parts relationships **206** and product definitions **208**. Maintenance system **202** uses a user interface that includes the ability to add items to parts catalog **204** and specify part relationships **206** and product definitions **208**. The user interface displays a set of hierarchies that provide a conceptually easier way of viewing a definition. The invention maps the set of hierarchies (an external representation) to an internal representation.

The internal representation is used by configuration system **212** to maintain and configure systems based on user input. Configuration system **212** provides the ability to specify a product. Configuration system **212** verifies the product specification. Using configuration system **212**, a user can interactively select and configure a product among a set of related products based on availability and compatibility of features and options. It does not impose an order in the selection of products, features or options. The configuration system **212** allows the user to only make valid selections. However, selections can be made in any order.

Parts catalog **204** consists of parts that are components of products. Similar parts are grouped together to form a part hierarchy. Easy maintenance of relationships is achieved by the hierarchy. For example, when a group of parts is assigned a behavior, all the members inherit that behavior automatically. FIG. **3** illustrates examples of elements in a parts catalog according to an embodiment of the invention. Referring to FIG. **3**, a parts catalog (e.g., parts catalog **204**) contains parts **302–310**, **316**, and **318**. A parts catalog can also contain a group of parts such as group **312**. Group **312** contains parts **306–310**. A group can contain other groups. For example, group **314** contains group **312** and parts **316–318**. Behavior assigned to elements of group **314** is inherited by members of group **312**.

Part-to-part relationships can be created between parts within a product. Relationships are defined between a first set of parts and a second set of parts. During configuration, when all of the members of the first set of parts are selected, the relationship between the two sets is enforced on the parts in the second set. In the preferred embodiment, there are four kinds of relationships between parts: requires choice, includes, can't work with (or excluded), and removes. FIG. **4** illustrates relationships between parts according to an embodiment of the invention.

Part **402** includes part **404**. The includes relation causes a set of parts in a second set (e.g., part **404**) to be included in the configuration when a first set of parts (e.g., part **402**) is selected. For example, a luxury package includes a CD player; when the luxury package is selected, a CD player is included in the configuration. The can't work with (or excluded) relation ensures that a set of parts from a second set are never in the same configuration as parts in the first set. For example, part **402** (e.g., sun roof) can't work with part **406** (e.g., a roof-top antenna). When part **402** is selected, part **406** cannot be selected. Part **406** is excluded such that it cannot be selected.

When part **402** is selected, part **414** is removed from the configuration. The removes relation causes items that are included in a second set of to be removed from the configuration when the left side is selected. For example, when a high end stereo is selected the standard stereo is removed from the configuration.

The requires choice relation recognizes that a choice (between a minimum and maximum number) has to be made between a second set of parts (or members of a group) to ensure a valid configuration when the parts in a first set are selected. Part **406** (e.g., climate control feature) requires that a choice be made among parts **408–410** (e.g., 1 zone A/C or 2 zone A/C). A requires choice relationship requires that a number of items be selected based on minimum and maximum values from the right-hand side of the relationship to satisfy the relationship.

Parts **408** and **410** can be combined to form group **416**. Group **416** can be defined by the user. If the user does not define group **416**, the invention preferably creates group **416** to contain parts **408** and **410**. Thus, when two or more parts are defined on the right-hand side of a requires choice relationship, the invention preferably creates a group that contains these parts. The requires choice then becomes a requires choice on the group (e.g., group **416**).

Parts are used to illustrate relationships in FIG. 4. However, a relationship can contain groups. To illustrate, a group of parts can be substituted wherever a part is used in the illustration. Thus, for example, parts **402, 404, 406, 408, 410,** and **414** can each be replaced by a group of parts. Thus, for example, if parts **402** and **404** are replaced by groups (e.g., groups **402** and **404**, respectively), when the members of group **402** are selected, the members in group **406** are included in the configuration. To further illustrate, part **408** can be replaced by group **408**. In that instance, group **408** is a member of group **416**. A hierarchy of groups (e.g., group **408** contained within group **416**) can be used in a relationship.

Parts can be combined to form an arbitrary grouping. Thus, it is not necessary to combine parts in a group based on a logical or intuitive relationship between the parts in the group. For example, a group can contain an engine, a color, and a sun roof.

The relations that are created between parts within a product are enforced only on that particular product. However, if some part-to-part relationships are to be enforced on all products within a product line, then the relations are created once and are enforced for all products. These relationships are referred to as global relationships.

A product includes zero or more elements of parts catalog **204**. Product definition **208** (see FIG. 2) is generate by populating it with its component parts. Product definition **208** is generated by population of a product with its component parts. The parts within a product are classified as one of three different types: included parts, required choices, or optional parts. A part that is not classified as one of these types is assumed to be unavailable in that product. FIG. **5** provides an example of product classifications according to an embodiment of the invention.

An included part is a part that is included in a product by default. For example, parts **504** and **506** are automatically included in product **502**. for example, when a configuration user chooses the product definition product **502**, the parts **504** and **506** are automatically included in the configuration. A required choices classification specifies that a choice among a group of parts has to be made to create a valid product configuration. For example, product **502** (e.g., automobile) can include a color group **518** containing red (part **508**), green (part **510**) and blue (part **512**) that is a required choice. In configuring a product, the user must choose a color in this group to create a valid product configuration. Parts **514** and **516** are optional parts. An optional part is not required for a valid configuration.

A product line is defined as a set of related products. The invention provides the framework for defining a product line. To define a product line: all parts (components) in the product line are entered into parts catalog **204**. An instance in products definition **208** is created that identifies parts from parts catalog **204** that are assigned to a product. Part relationships **206** can also be defined for the product.

Maintenance System

Parts catalog **204**, part relationships **206**, and product definition **208** are created and maintained using maintenance system **202**. While any method can be used for creation and maintenance, a graphical user interface (GUI) is preferably used. A text editor could also be used for data entry, for example. FIG. **6** provides an example of a GUI screen used in maintenance system **202** according to an embodiment of the present invention. One who uses the GUI screen (a maintainer) can define a product (e.g., an automobile). A product definition is used by a configuration user to configure a system defined in maintenance system **202**. Parts catalog **204** uses a database or other type of storage and retrieval capability, for example, to store information about its parts (e.g., part number, description, price, etc.).

The GUI screen of FIG. **6** is divided into a product definition section **650** and a part relationship definition section **652**. Pane **602** displays elements from parts catalog **204**. Panes **604, 606, 608** are used to define a product. Panes **604, 606,** and **608** represent classifications or product relationships. Panes **610** and **614** and relationship **612** are used to define part relationships.

A user can drag elements from pane **602** to panes **604–608** to define a product. For example, to include Part B in the product definition, Part B is dragged from pane **602** to pane **604**. Alternatively, to drag parts B, C, D, and E, group A can be dragged from pane **602** to pane **604**. Group A and its component parts (parts B, C, D, and E) are thereby included in the product definition. Similarly, a user can specify that a configuration user must choose a part from a group, e.g., Group I, by dragging one or more parts or a group into pane **606**. An optional part or group can be identified by dragging an element, e.g., Group L, into pane **608**. If an element from pane **602** is not moved to one of panes **604–608** it is assumed that the maintainer wants to exclude that element from the product that is being defined. The product-level relationships or classifications (or types) illustrated in FIG. **5** can be defined using panes **604–608**.

A subset of the product-level relationships map to a subset of the part relationships. For example, the include and requires choice product-level relationships map to the same named part relationships (as defined in FIG. **4** and shown in relationships **612**). Minimum and maximum values set for a requires choice product-level relationship map to the minimum and maximum values of a requires choice part relationship. Elements that are not dragged into one of panes **604, 606** or **608** are considered to be excluded.

In addition to defining the elements (and their types) that comprise the product, the maintainer can specify relationships between parts of the product. Panes **610** and **614** and relationship **612** are used to define relationships between parts. The maintainer can drag an element (or elements) from pane **602** into pane **610**. For example, the user can drag Part N from pane **602** into pane **610**. The element(s) dragged into pane **610** are referred to as the left-hand side of the relationship. The element (or elements) from pane **602** that is related to the left-hand element(s) is dragged into pane **614**. The element(s) dragged into pane **614** are referred to as the right-hand side of the relationship. For example, the user can drag Part K from pane **602** to pane **614**.

To identify the type of relationship that exists between the left-hand side and right-hand side elements, the maintainer chooses one of the four part-to-part relationships from relationship **612**. For example, if the maintainer chooses the includes relationship, the right-hand side elements are included in the product when a configuration user selects the left-hand side element(s). Thus, for example, Part N includes Part K. When Part N is chosen by a configuration user, Part K is automatically included in the configuration.

When the maintainer completes the product definition using the GUI screen, the product definition is saved (e.g., in parts definition **208**). The product definition can then be used by a configuration user in configuration system **212**.

External and Internal Representations

The GUI screen of FIG. **6** illustrates a view of a product as seen by a user (e.g., maintainer and configuration user). A view of the product that is seen by a user is referred to as the external representation. A user sees a product or product

definition from a conceptual level that is easy to understand. The user does not need to express a definition or configuration using a language that has a syntax that is foreign to the user. A GUI having graphical selections and operations is preferably used to allow the user to see the external representation. The external representation uses terminology that is familiar or intuitive to the maintainer. For example, an include product relationship defines elements that can be included in a product.

An external representation seen by the user is translated into an internal representation that can be used by the invention to process user input. FIG. **7** provides a block diagram illustrating the conversion process according to one embodiment of the invention. Compiler **704** is used to perform the conversion. Compiler **704** generates internal representation **706** from external representation **702**.

External representation **702** is the representation of a product definition that is created using the maintenance system of the invention. External representation **702** provides a graphical representation of a system definition, its components and their interrelationships. FIG. **6** can be used to display external representation **702**. External representation **702** can include a multi-level hierarchy of parts that help to define the product at a conceptual level. The hierarchies are not required to drive a configuration session, however. Therefore, compiler **704** flattens out the hierarchies. A set of relationships is generated using external representation **702** during a translation process.

The set of relationships generated for a system definition by compiler **704** comprise internal representation **706**. Internal representation **706** is generated from external representation **702** and can be used to control a configuration session. In addition to internal representation **706**, a configuration state is used during the configuration session. FIGS. **8A–8B** illustrate components of internal representation **706** and the configuration state according to an embodiment of the invention.

Referring to FIG. **8A**, vector **802** provides an example of a vector used to store state information. Vector **802** is comprised of bits. A set of p bits is used to represent the products that are known to maintenance system **202** and configuration system **212**. Each bit of the P bits corresponds to a product. A set of N bits is used to represent the parts. Each bit in the N-bit set corresponds to a part in parts catalog **204**, for example. Vector **802** is therefore P+N bits in length.

Vectors **804–810** provides implementation examples of vector **802**. Vectors **804–810** are maintained by configuration system **212** in a configuration session. Vector **804** is a user vector that contains the set of elements that are selected by the user. Vector **804** is referred to as the user vector, or uVec. The set of elements that are included in the configuration by the configuration system (e.g., an item that is automatically included when the user selects the left-hand in an includes relationship) is contained in included vector **806**, or iVec. Removed vector **808**, or rVec, contains the elements that are removed from the configuration by configuration system **212**. Elements excluded from the configuration by configuration system **212** are identified in excluded vector **810**, or xVec.

Each element that can be used to configure a system has a bit in these vectors. When an element is included, excluded, removed (or deleted), or selected, the corresponding bit in the appropriate vector (iVec, xVec, rVec, or uVec) is set. The use of vectors to represent elements results in increased efficiency in processing. Bit-wise operations can then be used during processing. For example, it is possible to determine whether a group of elements have been selected by the user by performing a bit comparison using the uVec. The increased efficiency results in optimal response times that are necessary for an interactive system such as is preferred for configuration system **212**. The bit vector implementation used by the invention allows for fast and efficient computation of runtime algorithms. A bit vector implementation of relationships and internal runtime state allows for fast and efficient computation of relationship based configuration.

Another vector that contains state information is required groups vector **812**, or rgVec. The rgVec contains a bit for each of the required groups specified for a product. As previously discussed, the maintainer can include a required group in a product definition by dragging a group from pane **602** to pane **606**, for example (see FIG. **6**). The number of bits in rgVec can differ from the number of bits in vectors **802–810**. The number of bits contained in rgVec corresponds to the total number of required groups defined for a product. Each bit in rgVec is set to indicate that it has not yet been satisfied. It is unset (set to zero) when a required group has been satisfied. Thus, when a user attempts to accept a configuration, configuration system **212** can determine whether all of the required choices have been satisfied.

In addition to these vectors, additional vectors are used to determine a current state. The current state is defined by three types of state information that track the state of parts in the configuration. The current state is visible to the user. The three state types are: selected, selectable, and notSelectable. The selected state identifies all of the parts that are currently included in the configuration. The selectable state identifies the parts that are not in the configuration but that can be selected by the user for the configuration. The notSelectable state identifies the parts that are not in the configuration and cannot be selected by the user. Configuration system **212** ensures that only parts that can form a valid configuration are selectable; those that cannot are notSelectable.

The uVec, iVec, xVec, and rVec vectors can be used to generate the three visible states. The states are dynamic and can change based on user input. The following provides definitions using the formulae that can be used to generate the three visible states (+is union and–is difference):

$$Selected=(uVec+iVec)-rVec$$

$$NotSelectable=xVec+rVec$$

$$Selectable=[AllItems]-Selected-NotSelectable$$

Computation of the visible state using C++, for example, can be accomplished using the following C++ code (the syntax assumes appropriate bit-wise operator overloads for the given operations):

```
SelectedVec=(uVec|iVec)&~rVec

NotSelectableVec=xVec|rVec

SelectableVec=~(SelectedVec|NotSelectableVec)
```

The selected state is the union of the elements selected by the user or automatically included in the configuration minus the elements removed by configuration system **212**. The notSeletable state is the union of the elements that are excluded or removed. The selectable state is the set of all elements minus the elements already selected and the elements that cannot be selected. The selected, selectable, and notSelectable states can be generated from these four vectors when needed. They can be stored as vectors that have the structure of vector **802**.

Runtime tables are preferably used to store internal representation **706** for a configuration session. FIG. **8**B provides an example of runtime tables. Runtime table **822** provides an example of a runtime table. Runtime table **822** can be used to store relationship information. Runtime table **822** has left-hand side **824** and right-hand side **826**. Left-hand side **824** contains the left-hand side of a relationship (e.g., includes, removes, can't work with or excludes). The right-hand side of a relationship is stored in right-hand side **826**.

Table **828** provides an example of runtime table **822**. Table **828** can be an includes, excludes, or removes table, for example. Left-hand side **830** contains a bit vector (i.e., "01010 . . . 0"). Right-hand side **832** contains a bit vector (i.e., "10001 . . . 1"). Each bit in bit vectors **830** and **832** corresponds to an element in parts catalog **204** or a product. For example, if the product definition is for an automobile, each "1" bit in bit vector "01010 . . . 0" corresponds to a part in parts catalog **204** that is contained in an automobile's product definition. Zero bits indicate that the part is not included in the product definition. With reference to bit vectors, parts can be identified by the position of their corresponding bit in the bit vector. For example, the part (that corresponds with the "1" bit in the bit vector "0010" is part number three.

If table **830** is an instance of an includes table, when parts designated on left-hand side **830** (e.g., part numbers two and four) are selected, configuration system **212** includes the parts designed in right-hand side **832** (e.g., part numbers one and five). Similarly, if table **830** is excludes (or can't work with) table, parts one and five are excluded from the selectable parts when parts two and four are selected. Parts one and five are removed from the configuration when parts two and four are selected.

Like the includes, excludes, and removes tables, the requires choice table contains a left-hand side and a right-hand side. In one embodiment, both sides of the requires choice table contains a bit vector that corresponds to elements in parts catalog **204**. Thus, for example, when selected, the part(s) identified on left-hand side **836** require a choice of a minimum and maximum number of parts from the parts contained on the right-hand side **838**.

Table **822** can be altered to optimize the storage and use of information for a required choice table. Table **834** provides an example of an altered table **822**. Preferably, however, right-hand side **838** contains a pointer to a group table (e.g., group table **840**) that contains a bit vector (bit vector **842**) that identifies the parts contained in the group. An advantage that the latter (altered table **822**) format has over the former (unaltered table **822**) is that it is only necessary to define the members of a group once. Each product definition that includes the group can point to the entry in the group table that contains the group definition.

One relationship table can be used for all products per relationship type. That is, a single includes table is used for includes relationships for all of the products. Alternatively, a table can be partitioned for each product. That is, the relationships associated with a product are segregated. For example, there would be a includes relationship table for each product. This has the advantage of only having to process only those relationships that exist for the chosen product. When a product is unselected or not selectable, there is no need to process the tables associated with that product. The latter alternative is preferable because it lessens processing requirements.

Configuration System

Using configuration system **212**, a configuration user can configure a system given a product definition (e.g., product definition **208**) and part relationships associated with the product definition. Configuration system **212** accepts a configuration user's input and processes it to update the configuration based on the user's input or notify the user that the input is invalid given the current state of the configuration and the system definition. Configuration system **212** ensures that the current configuration state (determined by the product definition and order-independent user selection) is always valid.

User Selection

When user input is received by configuration system **212**, it is processed based on the current configuration state, the product definition and the parts relationships. FIG. **9** provides a process flow for processing a user selection according to an embodiment of the invention.

At step **902**, the user selects item n (e.g., part) preferably using a GUI screen. At step **904** (i.e., "n selectable?"), a determination is made whether the item is selectable. Thus, for example, configuration system **212** determines whether the nth bit in the selectable state information is set. If it is not, configuration system **212** determines that the item is not selectable by the user and raises an error at step **922**. Processing then continues at step **914** to update the interface (if necessary) and return control of the GUI screen to the user. Processing of the current input ends at step **916**.

If, however, it is determined at step **904** that the item selected by the user is selectable, processing continues at step **908** to set the nth bit in uVec **804**. At step **910**, the visible state information is updated as discussed above. At step **912**, the relationships associated with the product definition are evaluated as discussed below. Processing continues at step **914** to update the interface (if necessary) and return control of the GUI screen to the user. Processing of the current input ends at step **916**.

Relationship Evaluation

Relationships associated with items contained in the product definition are evaluated when user input is received. Configuration system **212** determines what relationships are active and inactive given the user input (at step **912**, for example). A relationship is active when all the items on the left-hand side of the relationship are selected. A relationship is inactive until all of the parts on the left-hand side of the relationship are selected.

As previously discussed, relationship tables can be used to store the left-hand and right-hand sides of a relationship. That is, a relationship can be defined as a pair of bit vectors, the lhsVec (left-hand side) and the rhsVec (right-hand side). A relationship is made active if the following expression is true:

```
SelectedVec & lhsVec==lhsVec
```

When a relationship is made active, updating the appropriate state vector (iVec, xVec, or rVec) becomes:

```
stateVec|=rhsVec
```

An active relationship causes the configuration state to be updated. When an include relationship is activated, for example, parts identified on the right-hand side of the include relationship are added to the configuration, if they are not already included. The state is changed by modifying iVec **806**. A change in iVec **806** can change other state information such as the selected and selectable state information. Parts that are included as a result of the activation of the includes relation can result in a ripple effect that causes other relationships to become activated. Thus, additional state changes can occur as a result of the include relationship's activation.

To further illustrate, when a requires choice relation becomes active, configuration system **212** includes and excludes items of the given group where applicable: if exactly max (maximum number of) items of the given group are selected, the engine excludes all other items in the group (added into xVec); otherwise, if less than min (minimum number of) items of the group are selected and only one valid selection path exists to make exactly min items selected, the engine includes (into iVec) the items that are needed (note that these must have been selectable items).

Configuration system **212** also ensures that no relationship that will put the configuration into an invalid state can become active (for example: if b is Selected then the relationship [a] can't work with [b] should not be active). If a relationship will make a configuration invalid, it is made notActivateable. For example, a relation should be made notActivateable, if:

1) an includes relationship has excluded (xVEc) parts on the right-hand side;
2) a excludes (can't work with) relationship has Selected parts on the right-hand side;
3) a removes relation has user-selected (uVec) parts on the right side; or
4) a requires choice relation has a group for which between [min, max] parts can't be Selected.

In addition to the relationships created by a maintainer, there are some relationships that are dynamically created or deduced at runtime. If a relation becomes notActivateable and all but one item from the left-hand side is Selected, then the unSelected item is excluded by the engine. This ensures that the relation will not become active.

Configuration system **212** evaluates each relationship forward and backward. In a forward evaluation, the left-hand side of a relationship is examined to determine whether all of its parts are included in the configuration. If they are, the relationship is considered to be active. An active relationship causes the right-hand side of the relationship to then be evaluated. The evaluation is dependent on the type of relationship. An includes relationship causes the parts specified in the right-hand side to be included in the configuration specification. A removes relationship causes the right-hand side parts to be removed from the configuration. An excludes relationship cause the left-hand side parts to become notSelectable. A requires choice relationship recognizes that a choice has to be made by the user between the set of right-hand parts.

In a backward evaluation, configuration system **212** determines whether a relationship if activated would result in an invalid state. If so, configuration system **212** takes steps to ensure that the relationship cannot be activated. Instead of evaluating the left-hand side first as in the case of a forward evaluation, a backward evaluation evaluates the relationship by first examining the right-hand side. If a relationship fails the backward evaluation (i.e., its activation would result in an invalid state), configuration engine **212** takes steps to ensure that the relationship cannot become active. For example, if a relationship states that part A can't work with part B and part B is selected, configuration system **212** excludes part A. This ensures that part A cannot be selected and the excludes relationship cannot become active. Otherwise, a user can select part A which would result in an invalid configuration state.

The invention performs a relaxation over the set of relationships. A relaxation is an iterative process that is repeated until a state that has been defined no longer changes. That is, relationship evaluation is completed when none of iVec, xVec, or rVec are modified during an iteration. The invention ensures that the relaxation process terminates by only adding bits to the state. That is, because iVec, xVec, and rVec all grow through the iteration, the relaxation process is guaranteed to terminate.

FIG. **10** provides an example of a relationship evaluation process flow according to an embodiment of the invention. At step **1002**, rgVec is initialized to zero. During the relationship evaluation, rgVec is regenerated. At step **1004**, copies of iVec, xVec, and rVec are made. The copies are used to determine whether relaxation is finished. At step **1006**, the includes table associated with the product definition is evaluated in the forward direction. Similarly, forward evaluation is performed on the excluded and removed tables. The forward evaluation performs an "or" operation with the selectedVec and a specified configuration state vector (e.g., a forward evaluation of the includes table performs an "or" operation with the selectedVec and and the iVec) when the left-hand side of the relationship is true. For example, when the items that correspond with the "1" bits in left-hand side **830** are all selected (i.e., in the selected vector), right-hand side **832** is "or'ed" with the iVec to add the items that correspond with the "1" bits in right-hand side **832** to the configuration where a forward evaluation of an includes relationship is being performed.

At step **1008**, a backward evaluation is performed on the relationships contained in the includes, excludes, and removed tables. In a backward evaluation of an include relationship, the xVec is examined to determine whether any right-hand side items of an include relationship are excluded. If so, selection of all of the left-hand side items would result in an invalid configuration state. Therefore, the last remaining left-hand side item (if only one remains) is excluded to cause the relationship to never become active. Thus, the relationship is rendered notActivateable.

Backward evaluation of an excluded relationship examines the selectedVec. If a left-hand side item (an item that is supposed to be excluded when the relationship becomes active) is selected, selection of all of the left-hand side items would result in an invalid configuration state. To ensure against an invalid configuration state, a left-hand side item is excluded so that the relationship never becomes active (the relationship is rendered notActivateable).

In the preferred embodiment, configuration system **212** cannot delete, or remove, a user-selected item. The uVec is examined in a backward evaluation of a removes relationship. If a right-hand side item is a user selected item, the selection of all of the left-hand side items would result in an invalid configuration state. To ensure against an invalid configuration state, a left-hand side item is excluded so that the relationship becomes notActivateable.

At step **1010**, backward and forward evaluation is performed on the requires choice table **834**. In the backward evaluation, a determination is made whether a requires choice relationship should become notActivateable. For example, if it is impossible to satisfy a group, then a left-hand side item should be excluded to cause the relationship to become notActivateable.

In the forward evaluation, rgVec is set and items are included or excluded where appropriate. For example, if the right-hand side items are within range (within min and max values for the required choice relationship), then the remaining right-hand side items are excluded. If the only way to make a requires choice valid is to select the items remaining on the right-hand side item, configuration system **212** includes these items. In addition, a requires choice relationship is evaluated to determine whether the right-hand side items selected are within a valid range. If not, the corre-

sponding bit in the rgVec is set. If so, the corresponding bit in the rgVec is zeroed.

The selected, selectable, and notSelectable states are updated at step **1012**. At step **1014** (i.e., "change in a vector?"), a determination is made whether any of iVec, xVec, or rVec were modified during the current iteration of the relaxation process. If not, a stable state has been achieved, and processing ends at step **1016**. If so, additional iterations are needed to complete the relaxation process. Processing therefore continues at step **1002** to initiate a new iteration.

In evaluating relationships, it is not necessary to evaluate a relationship in either the forward or backward direction once it has become active. Also, when a relationship is notActivateable, there is no need to evaluate the relationship in the forward direction. When a relationship is notActivateable and has been excluded, there is no need to evaluate in the backward, or reverse, direction.

Unseletion

FIG. **9** described processing where the user input was an item selection. Configuration system **212** also processes user input to unselect an item from the configuration. As previously discussed, an item can be unselected in any order. There is no requirement to unselect items the reverse order in which they were selected. FIG. **11** provides an example of an unselect item process flow according to an embodiment of the invention.

At step **1102** (i.e., "selection in uVec?"), a determination is made whether the item that is selected for deletion was selected for inclusion in the configuration by the user. If it is determined that the item is not a user-selected item, processing continues at step **1104** to raise an error. Processing continues at step **1114** to update the GUI (if necessary) and return control to the user. Processing of the current input ends at step **1116**.

If it is determined at step **1102** that the item selected for unselection was selected by the user, processing continues at step **1106** to reset the bit in the uVec that corresponds to the unselected item (i.e., set the bit to zero). This unselects the item from the current configuration. At step **1108**, the iVec, xVec, and rVec vectors are initialized (set to zero). Steps **1110**, **1112** and **1114** correspond to steps **910**, **912**, and **914**, respectively, of FIG. **9**. Processing ends at step **1116**.

Translation Between Representations

To ensure correct runtime behavior of the engine, a potentially incomplete user-defined set of relationships is converted into a set of complete runtime relationship tables. The external representation is translated into an internal representation. The invention maps the hierarchies contained in parts catalog **204** to relationships and maps relationships to the runtime tables, for example.

As discussed above, compiler **704** performs a mapping between product-level relationships and part-level relationships. The translation process further provides the ability to translate a multi-level hierarchy to a single-level hierarchy. That is, the translation process can be used to flatten out the intuitive hierarchy created by a maintenance user using the user interface of FIG. **6**, for example. FIG. **12** provides a flow for translation processing according to an embodiment of the invention.

At step **1202**, a set of relationships is created based on the hierarchies. Thus, for example, group **312** is translated into an requires choice relationship. That is, group **312** requires a choice between parts **306**, **308**, and **310**. Relationships can be defined in terms of groups. An identifier (item ID) is used to identify the group. When a group appears on the left-hand side of a relationship, the group is assigned an item ID and the relationship is defined in terms of the new item ID. This process, referred to as back-linking, is performed at step **1204**.

At step **1206**, an include chain evaluation is performed. In an include chain evaluation, all include relationship chains are fully evaluated so that relationship contains all of the parts that are included in part regardless of whether the included relationship is direct (e.g., mentioned in the includes relationship) or indirect (mentioned in another includes relationship that contains an included part on the right-hand side).

At step **1208**, subgroup excludes are evaluated. In this process, active requires choice relationships are evaluated where one relationship's right-hand side is a subset of another relationship's right-hand side. In this case, if both relationships are active, the right-hand side parts that are not within the subset are excluded. Relationship factorization is performed at step **1210**. Relationship factorizing can create new relationships that ensure proper runtime behavior when more than one item is selected during some iteration.

Removing redundancy in relations may cause some relations to become unnecessary. A relation becomes unnecessary when it contains no items on its right side. Redundant relationships are removed at step **1212**. Processing ends at step **1214**.

Back-Linking

Relationships can be defined in terms of groups. When a group appears on the left-hand side of a relationship, the group is assigned an item ID and behaves as a normal item (e.g., part) and the relationship is defined in terms of this new item ID. A relationship is defined for each item in the group:

item includes item ID (of the group)

It is only necessary to create this relationship once per group, regardless of how many times that group appears on the left side of a relationship. Back-Linking can be used to generate relationships in nested groups. FIGS. **13A–13B** provide an illustration of groups and nested groups according to an embodiment of the invention. Group **1302** contains two items (groups **1304** and **1306**) that are nested within group **1302**. Notation is provided for a group to specify the minimum and maximum bounds for a group. For example, the notation "(0,1)" indicates that between zero and one items in group **1302** are to be chosen.

The items contained in group **1302** are also groups that contain multiple items. Groups **1304** and **1306** are nested within group **1302**. Two or three of parts **1308–1312** can be chosen from Group **1304**. Zero to three of parts **1314–1318** can be chosen from Group **1306**.

The invention creates a metapart for these groups (groups **1302–1306**). Relationships are then created between the groups and their members such that items are back-linked to their parents. FIG. **13B** provides an illustration of metaparts for the groups and nested group of FIG. **13A** according to an embodiment of the invention. Groups **1302'–1306'** are metaparts for groups **1302–1306**, respectively. Relationships can be generated using these metaparts as follows:

Group **1302'** requires choice [Group **1304'**, Group **1306'**] **0,1**

Group **1304'** requires choice [part **1308**, part **1310**, part **1312**] **2,3**

Group **1306'** requires choice [part **1314**, part **1316**, part **1318**] **0,3**

The metapart is used internally; it is unnecessary for a user to be aware of them. Using back-linking, relationships can be generated such that an item (e.g., part **1308**) links back to its predecessor(s) (e.g., nested group, group **1302**).

The following new relationships can be created for the examples of FIGS. 13A–13B:

Group **1304'** includes Group **1302'**

Group **1306'** includes Group **1302'**

Part **1308** includes Group **1304'**

Part **1310** includes Group **1304'**

Part **1312** includes Group **1304'**

Part **1314** includes Group **1306'**

Part **1316** includes Group **1306'**

Part **1318** includes Group **1306'**

When a user selects part **1308**, part **1308** includes group **1304'**. Group **1304'** is added to the configuration. Further, group **1304'** includes group **1302'** thereby including group **1302'**. When group **1302'** is included in the configuration, it activates the relationship that requires a choice between groups **1304'** and **1306'**. Since group **1304'** is already selected, group **1306'** can be excluded. When group **1306'** is excluded, parts **1314–1318** are excluded when the newly generated relationships are evaluated in the reverse (backward) direction. Further, the bounds specified by group **1304** are also enforced using these relationships.

As discussed above, a requires choice relationship can be defined at the product level. A product can require a choice between items in a group. The product-level requires choice relationship is treated similarly to that of a requires choice part-level relationship.

Include Chains

In an include chain evaluation, all include relationship chains are fully evaluated so that a relationship can be generated that contains all of the parts that are included regardless of whether the relationship is direct (e.g., the included parts mentioned in the includes relationship) or indirect (a part is mentioned in another includes relationship that contain an included part on the right-hand side). For example, the following relationships exists in the external representation:

a includes b and c

b includes d

d and c includes e

An include chain exists that starts with a. The first relationship indicates that a includes b and c. Based on the second and third relationships, b and c include other parts. Based on all of the relationships, a includes b, c, d, and e. Include chain evaluation expands these relationships into the following relationships:

a includes b and c and d and e

b includes d

d and c includes e

It is not necessary to generate additional relationships to perform includes chain evaluation. Preferably, includes chain evaluation can modify an existing relationship to include both direct and indirect includes relationships. Each includes relationship can be evaluated against all other includes relationships to determine whether its right-hand side should be modified to include both direct and indirect includes relationships. Once all of the includes relationships have been evaluated, a new right-hand side value can be generated based on the evaluation. FIGS. **14A–14B** provide an includes chain process flow according to an embodiment of the invention.

At step **1402** (i.e., "all include rels processed?"), a determination is made whether all of the includes relationships have been processed. If other includes relationships remain to be processed, processing continues at step **1408** to get the next includes relationship, r. At step **1410**, a temporary vector, temp, is created that is the result of an "or" operation between the left-hand and right-hand sides of r. Another temporary vector, tempsave, is created that is set to the value of temp at step **1412**. At step **1414** (i.e., "all rels. compared?"), a determination is made whether all of the other includes relationships have been evaluated against r. If not, processing continues at step **1418** to get another relationship, r_2. At step **1420** (i.e., "temp hits r_2?"), a determination is made whether any of the items contained in temp are also contained in r_2. If not, processing continues at step **1414** to process any remaining relationships against r. If so, processing continues at step **1422** to perform a "or" operation between temp and the right-hand side of r_2 to add the right-hand side of r_2 to the temp vector.

If it is determined, at step **1414**, that all of the relationships r_2 have been evaluated for r, processing continues at step **1416**. At step **1416** (i.e., "temp=tempsave?"), a determination is made whether any items were added to the temp vector. If not, there are no indirect includes and processing continues at step **1424** to reset r_2 and processing continues at step **1414** to process any remaining relationships against this relationship. If so, processing continues at step **1404** to modify the right-hand side of r to include the items contained in the temp vector minus the items contained in the left-hand side of r. Processing continues at step **1402** to process any remaining relationships.

If it is determined at step **1402** (i.e., all include rels. processed?") that all of the includes relationships have been evaluated for include chains, processing ends at step **1404**.

Subgroup Excludes

The subgroup excludes evaluation is performed on requires choice relationships. Assume a requires choice relationship points to a group (A) that is a complete subgroup of a group (B) of another requires choice relationship. If B has a max of 1 and both relationships are made active, the items in B that are not in A, Q, cannot be chosen. If a pairwise comparison of requires choice relationships yields such cases, a relationship such as the following is generated:

[union of left sides of both relationships] can't work with Q

For example, assume that the following relationships have been defined:

a b requires choice [x, y, z] (0,1)

d requires choice [x, y] (0,2)

The second relationship contains a group that is a subgroup of the first relationship. When both relationships are active, the non-subset is excluded. This avoids the case where a user selects a, b, and d and the relationship evaluations do not exclude the items not included in both groups (the non-subset). The invention combines these relationships and creates an excludes relationship. The excludes relationship for the above example is as follows:

a b d excludes z

FIGS. **15A–15B** provides an example of a subgroup excludes process flow according to an embodiment of the invention. At step **1502** (i.e., "all rels. processed?"), a determination is made whether all of the requires choice relationships have been processed. If so, processing ends at step **1504**. If not, processing continues at step **1506** to get the next relationship, r. At step **1507** (i.e., "r.rhs.max=1?"), a determination is made whether the maximum value for the relationship is equal to one. If not, processing continues at step **1502** to process any remaining relationships. If so, processing continues at step **1508**. At step **1508** (i.e., "all rels. compared?"), a determination is made whether all of the other requires choice relationships have been processed against r. If so, processing continues at step **1502** to process another requires choice relationship.

If not, processing continues at step **1510** to get another relationship, r_2. At step **1512** (i.e., "r=r_2?"), a determination is made whether the two relationships are equal. If so, processing continues at step **1508** to process any remaining requires choice relationships against the current r. If r and r_2 are not equal, processing continues at **1514**. At step **1514** (i.e., "r2.grp subset of r.grp?"), a determination is made whether the right-hand side of r_2 is a subset of the right-hand side of r. If not, processing continues at step **1508** to process any remaining requires choice relationships against the current r. If so, processing continues at step **1516** to create an exclude relationship where the left-hand side is the union of the left-hand side of r and r_2 and the right-hand side is the non-subset of the right-hand side of the two relationships. Processing continues at step **1508** to process any remaining requires choice relationships against the current r.

Relationship Factorization

The invention assumes that one item on the left side of a relationship is preferably selected during any iteration. However, the includes and requires choice relationships may cause additional items to become selected (e.g., selected by the system). Factorizing of relationships can create new relationships to ensure proper runtime behavior when more than one item is selected during some iteration.

Factorization causes a relationship to be created where a relationship has items on the left-hand side that also appear on the right-hand side of an includes relationship. The new relationship represents the common factorization of both relationships. For example, where the following two relationships exist:

[a] includes [b and c]

[b and c and d and e] can't work with [x and y]

the following relationship is created:

[a and d and e] can't work with [x and y]

The invention uses a technique in factorization that avoids combinatorial explosion. Relationships are created during factorization when they add value. The invention identifies value where the new relationship:

1. replaces more than one item from the left-hand side;
2. has at least two different includes relationships replace at least one unique item from the left-hand side of the relationship being factorized; and
3. the two includes relationships have at least one common item in their left-hand side.

FIGS. **16A–16C** provide an example of a relationship factorization process flow according to an embodiment of the invention. At step **1602**, each relationship is marked as "new". At step **1604**, a state variable, added, is initialized to "false". At step **1606** (i.e., "all includes rels. processed?"), a determination is made whether all of the includes relationships have been processed. If so, processing continues at step **1608** (i.e., "added='true'?) to determine whether any new relationships were added. If not, processing ends at step **1610**. If there are new relationships, processing continues at step **1609** to reset the includes relationships and processing continues at step **1604** to initialize added to "false".

If it is determined at step **1606** that all of the includes relationships have not been processed, processing continues at step **1612** to get the next includes relationship, i. At step **1613**, the relationships are reset. At step **1614** (i.e., "all 'new' rels. processed?"), a determination is made whether all of the relationships have been marked as "new" have been processed against i. If so, processing continues at step **1606** to process any remaining includes relationships. If not, processing continues at step **1616**.

At step **1616**, the next relationship, r, is marked as "old". At step **1620** (i.e., "!(r.lhs && i.rhs)?", a determination is made whether the right-hand side of the i relationship and the left-hand side of the r relationship have any bits in common. If they do not have bits in common, processing continues at step **1614** to process any remaining relationships against the current i. If they do have bits in common, processing continues at step **1622** to generate new.lhs from the includes relationship and the left-hand side of r. Step **1622** takes out items in the right-hand side of i from left-hand side of r and adds in items that are in the left-hand side of i. At step **1624** (i.e., "new.lhs has value?") a determination is made whether new.lhs has value. This determination can use the guidelines as specified above.

If new.lhs does not have value, processing continues at step **1614** to processing any remaining relationships against i. If it does have value, processing continues at step **1626** to add a new relationship (of the type r) that uses new.lhs as the left-hand side and the right-hand side of r. The new relationship is marked as "new" at step **1628**. The value of added is set to "true" at step **1630**. Processing continues at step **1614** to process any remaining relationships.

Relationship Compression

Removing redundancy in relations may cause some relations to become unnecessary. A relation becomes unnecessary when it contains no items on its right side. If a relationship's left-hand side is a proper subset of the left-hand side of another relationship, then the first relationship is guaranteed to be active whenever the second relationship is active. If both relationships are also the same type of relationship, the common right-hand side elements can be removed from the second relationship. This can be repeated to remove all unnecessary relationships. The following relationships provide an example:

[a] removes [c]

[a and b] removes [c and d]

The left-hand side of the first relationship is a proper subset of the left-hand side of the second relationship (e.g., all elements "a" in the left-hand side of the first relationship are contained in the left-hand side of the second relationship). The relationships are the same type. Therefore, the common right-hand side elements can be removed from the right-hand side of the second relationship. The following is the result after modifying the relationship:

[a] removes [c]

[a and b] removes [d]

FIGS. **17A–17B** provide an illustration of a relationship compression process flow according to an embodiment of the invention. At step **1702** (i.e., "all relationships in table processed?"), a determination is made whether all of the relationships in the table have been processed. If not, processing continues at step **1704** to get the next relationship, r. At step **1706** (i.e., "r processed against all other rels. in table?"), a determination is made whether the other relationships in the table have been processed against r. If so, processing continues at step **1702** to process any remaining relationships in the table as r.

If it is determined at step **1706** that all of the other relationships have not been processed against r, processing continues at step **1708**. Another relationship is retrieved as r_2 at step **1708**. At step **1710** (i.e., "r=r2?"), a determination is made whether the relationships are the same. If not, processing continues at step **1706** to process any remaining relationships against r. If so, processing continues at step **1712**. At step **1712** (i.e., "r.lhs subset of r2.lhs?"), a determination is made whether the left-hand side of r is a subset of the left-hand side of r_2. If the subset condition is true, processing continues at step **1714** to remove the common items out of the right-hand side of r (i.e., perform the

operation r_2.rhs=r_2.rhs and not r.rhs). Processing continues at step **1706** to process any remaining relationships against r.

If it is determined at step **1702** that all of the relationships have been processed as r, processing continues at step **1716**. At step **1716** (i.e., "all relationships in table processed?") a determination is made whether all of the relationships have been processed. If so, processing ends at step **1718**. If not, processing continues at step **1720** to get another relationship as r. At step **1722** (i.e., "r.rhs=zeroes?"), a determination is made whether the right-hand side of r has been set to zero has a result of compression. If not, processing continues at step **1716** to process any remaining relationships. If so, processing continues at step **1724** to delete r from the table. Processing continues at step **1716** to process any remaining relationships.

Global Relationships

Global relationships can be defined that are processed for all products. Thus, it is unnecessary to redefining a relationship for all of the products. The relationship can be defined as a global relationship that is applied for every product. If, however, partitioned relationship tables are used for each product, it is necessary to evaluate the relationships in a product's partitioned relationship tables as well as the global relationships. For example, the process flows described herein that operate on relationship tables can be performed once for the product's partitioned relationship tables and once for the global relationships.

Thus, a method and apparatus for maintaining and configuring systems has been provided.

We claim:

1. A method of configuring a system comprising the steps of:

generating a definition for said system, said definition containing one or more elements and being conveyed graphically using a set of product relationships, said product relationships identifying classifications for said one or more elements, said product relationships comprising an includes classification;

generating a set of part relationships between said one or more elements, said set of part relationships being conveyed graphically; and

configuring said system using said definition and said set of product relationships and said part relationships.

2. The method of claim **1** wherein said step of configuring further comprises the steps of:

receiving input from a configuration user;

validating said input based on said definition, said set of relationships, and a current configuration state; and

identifying a set of valid configuration options using said definition, said set of relationships and said current configuration state.

3. The method of claim **2** wherein said step of identifying further comprises the steps of:

determining whether a relationship in said set of relationships is active;

modifying said configuration to satisfy said active relationship when it is determined that a modification is needed;

making said relationship notActivateable when it is determined that said relationship is not active and the activation of said relationship would render the configuration invalid.

4. The method of claim **3** wherein said step of determining whether a relationship is active further comprises the step of determining whether the elements specified in the left-hand side of said relationship are present in said configuration.

5. The method of claim **4** wherein said step of determining whether the elements specified in the left-hand side of said relationship are present in said configuration further comprises the step of performing a bit-level comparison of the bits corresponding to the elements in said left-hand side of the relationship with a "selected" bit vector.

6. The method of claim **3** wherein said relationship is an includes relationship, said step of modifying further comprises the step of including in said configuration elements identified in a right-hand side of said relationship.

7. The method of claim **3** wherein said relationship is an excludes relationship, said step of modifying further comprises the step of marking said elements identified in the right-hand side of said relationship as excluded and notSelectable.

8. The method of claim **3** wherein said relationship is a removes relationship, said step of modifying further comprises the step of removing said elements identified in the right-hand side of said relationship from said configuration.

9. The method of claim **3** wherein said relationship is a requires choice relationship, said step of modifying further comprises the steps of:

determining whether a plurality of elements identified in a right-hand side of said relationship are present in said configuration such that said relationship is satisfied;

modifying said configuration to satisfy said requires choice relationship when it is determined that only one path exists to satisfy said relationship and said relationship is not already satisfied.

10. The method of claim **3** wherein said step of making said relationship notActivateable further comprises the step of marking one or more elements in said left-hand side of said relationship as notSelectable.

11. The method of claim **2** wherein said definition, each of said set of relationships, and said current configuration state are expressed as bit vectors having bits that correspond to elements.

12. The method of claim **2** wherein said step of validating further comprises the step of determining whether the relationships other than those marked notActivateable in said set of relationships can be satisfied.

13. The method of claim **2** wherein said step of generating a definition selects said one or more elements for inclusion in said definition, said input is made without regard for the order in which said one or more elements are selected for said definition.

14. The method of claim **2** wherein said configuration state identifies a set of selected elements and a set of selectable elements for said system, said input capable of selecting any member of said set of selectable elements and being made despite the order in which members of said set of selected elements were selected.

15. The method of claim **1** wherein a parts catalog is used to store information associated with said one or more elements, said information including an identifier and description.

16. A method for defining a system that can be configured comprising the steps of:

identifying an element of said system;

specifying said element as an included element when said element is automatically included in the configuration;

specifying said element as an optional element when said element is not a necessary component of said system;

specifying said element as a required choice when said element is a group that contains one or more members from which to choose.

17. The method of claim 16 wherein said element is a member of a first element set said first element set containing one or more elements, said method further comprising the steps of:

identifying a second element set of said system, said second element set containing one or more elements; and

specifying a relationship between said first element set and said second element set.

18. The method of claim 17 wherein said step of specifying further comprises the steps of:

specifying that said second element set is to be included in said system when said first element set is present in said system;

specifying that said second element set is to be excluded from said system when said first element set is present in said system; and

specifying that said second element set is to be removed from said system when said first element set is present in said system.

19. The method of claim 16 further comprising the steps of:

specifying a group of elements;

specifying a relationship between said first element set and said group of elements such that one or more elements in said group of elements must be chosen when said first element set is present in said system.

20. An article of manufacture comprising:

a computer usable medium having computer readable program code embodied therein for configuring a system comprising:

computer readable program code configured to cause a computer to generate a definition for said system, said definition containing one or more elements and being conveyed graphically using a set of product relationships, said product relationships identifying classifications for said one or more elements, said product relationships comprising an includes classification;

computer readable program code configured to cause a computer to generate a set of part relationships between said one or more elements, said set of part relationships being conveyed graphically; and

computer readable program code configured to cause a computer to configure said system using said definition and said set of product relationships and said part relationships.

21. The article of manufacture of claim 20 wherein said computer readable program code configured to cause a computer to configure further comprises:

computer readable program code configured to cause a computer to receive input from a configuration user;

computer readable program code configured to cause a computer to validate said input based on said definition, said set of relationships, and a current configuration state; and

computer readable program code configured to cause a computer to identify a set of valid configuration options using said definition, said set of relationships and a current configuration state.

22. The article of manufacture of claim 21 wherein said computer readable program code configured to cause a computer to identify further comprises:

computer readable program code configured to cause a computer to determine whether a relationship in said set of relationships is active;

computer readable program code configured to cause a computer to modify said configuration to satisfy said active relationship when it is determined that a modification is needed;

computer readable program code configured to cause a computer to make said relationship notActivateable when it is determined that said relationship is not active and the activation of said relationship would render the configuration invalid.

23. The article of manufacture of claim 22 wherein said computer readable program code configured to cause a computer to determine whether a relationship is active further comprises computer readable program code configured to cause a computer to determine whether the elements specified in the left-hand side of said relationship are present in said configuration.

24. The article of manufacture of claim 23 wherein said computer readable program code configured to cause a computer to determine whether the elements specified in the left-hand side of said relationship are present in said configuration further comprises computer readable program code configured to cause a computer to perform a bit-level comparison of the bits corresponding to the elements in said left-hand side of the relationship with a "selected" bit-vector.

25. The article of manufacture of claim 22 wherein said relationship is an includes relationship, said computer readable program code configured to cause a computer to modify further comprises computer readable program code configured to cause a computer to include in said configuration elements identified in a right-hand side of said relationship.

26. The article of manufacture of claim 22 wherein said relationship is an excludes relationship, said computer readable program code configured to cause a computer to modify further comprises computer readable program code configured to cause a computer to mark said elements identified in the right-hand side of said relationship as excluded and notSelectable.

27. The article of manufacture of claim 22 wherein said relationship is a removes relationship, said computer readable program code configured to cause a computer to modify further comprises computer readable program code configured to cause a computer to remove said elements identified in the right-hand side of said relationship from said configuration.

28. The article of manufacture of claim 22 wherein said relationship is a requires choice relationship, said computer readable program code configured to cause a computer to modify further comprises:

computer readable program code configured to cause a computer to determine whether a plurality of elements identified in a right-hand side of said relationship are present in said configuration such that said relationship is satisfied;

computer readable program code configured to cause a computer to modify said configuration to satisfy said requires choice relationship when it is determined that only one path exists to satisfy said relationship and said relationship is not already satisfied.

29. The article of manufacture of claim 22 wherein said computer readable program code configured to cause a computer to make said relationship notActivateable further comprises computer readable program code configured to cause a computer to mark one or more elements in said left-hand side of said relationship as notSelectable.

30. The article of manufacture of claim 21 wherein said definition, each of said set of relationships, and said current configuration state are expressed as bit vectors having bits that correspond to elements.

31. The article of manufacture of claim 21 wherein said code configured to cause a computer to validate further comprises program code configured to cause a computer to determine whether the relationships other than those marked notActivateable in said set of relationships can be satisfied.

32. The article of manufacture of claim 21 wherein said code configured to cause a computer to generate a definition selects said one or more elements for inclusion in said definition, said input is made without regard for the order in which said one ore more elements are selected for said definition.

33. The article of manufacture of claim 21 wherein said configuration state identifies a set of selected elements and a set of selectable elements for said system, said input capable of selecting any member of said set of selectable elements and being made despite the order in which members of said set of selected elements were selected.

34. The article of manufacture of claim 17 wherein a parts catalog is used to store information associated with said one or more elements, said information including an identifier and description.

35. An article of manufacture comprising

a computer usable medium having computer readable program code embodied therein for defining a system that can be configured comprising:

computer readable program code configured to cause a computer to identify an element of said system;

computer readable program code configured to cause a computer to specify said element as an included element when said element is automatically included in the configuration;

computer readable program code configured to cause a computer to specify said element as an optional element when said element is not a necessary component of said system;

computer readable program code configured to cause a computer to specify said element as a required choice when said element is a group that contains one or more members from which to choose.

36. The article of manufacture of claim 35 wherein said element is a member of a first element set said first element set containing one or more elements, said article of manufacture further comprising:

computer readable program code configured to cause a computer to identify a second element set of said system, said second element set containing one or more elements; and

computer readable program code configured to cause a computer to specify a relationship between said first element set and said second element set.

37. The article of manufacture of claim 36 wherein said computer readable program code configured to cause a computer to specify further comprises:

computer readable program code configured to cause a computer to specify that said second element set is to be included in said system when said first element set is present in said system;

computer readable program code configured to cause a computer to specify that said second element set is to be excluded from said system when said first element set is present in said system; and

computer readable program code configured to cause a computer to specify that said second element set is to be removed from said system when said first element set is present in said system.

38. The article of manufacture of claim 35 further comprising:

computer readable program code configured to cause a computer to specify a group of elements;

computer readable program code configured to cause a computer to specify a relationship between said first element set and said group of elements such that one or more elements in said group of elements must be chosen when said first element set is present in said system.

39. A method of configuring a system comprising the steps of:

translating a system definition from an external representation comprising a set of intuitive relationships between components of said system definition into an internal representation comprising a set of internal relationships;

validating configuration input using said internal representation; and

modifying a configuration state based on said user input.

40. The method of claim 39 wherein said step of translating further comprises the step of:

removing a plurality of hierarchical levels from said external representation such that said internal representation is a single level.

41. The method of claim 40 wherein said step of translating further comprises the step of:

creating a set of relationships based on said hierarchical levels, each one in said set of relationships having a first set of components and a second set of components and a relationship operator.

42. The method of claim 41 wherein said relationship operator is chosen from the operators include, exclude, remove, and requires choice.

43. The method of claim 39 wherein each of said internal relationships has a left-hand side, a relationship operator and a right-hand side, said step of translating further comprises the steps of:

determining whether a group of components exists on said left-hand side of one of said internal relationships;

performing the following steps when a group of components exist on said left-hand side:

creating a new component for said group; and

creating a new relationship for each component of said group of components such that each component will include said new component.

44. The method of claim 39 wherein a type of said internal relationships is an include relationship, said include relationship identifies a second set of components that are included in said system when all of a first set of components exist in said system, said step of translating further comprises the steps of:

determining whether a subset of the union of said first and second sets of components in a first includes relationship comprises a first set of components in a second includes relationship; and

generating a combined includes relationship, said combined relationship comprises said first set of components of said first includes relationship and said second set of components from said first and second includes relationships when said subset of the union of said first and second sets of components in said first includes relationship comprises a first set of components in a second includes relationship.

45. The method of claim 39 wherein a type of said internal relationships is a requires choice relationship, said requires choice relationship identifies a second set of components

from which a number of components must be chosen when a first set of components exist in said system definition, said step of translating further comprises the steps of:

determining whether a second set of components of a second requires choice relationship is a proper subset of a second set of components of a first requires choice relationship:

performing the following steps when said condition exists:

creating a new relationship such that said new relationship excludes a second set of components of said new relationship when a first set of components of said new relationship is selected, said new relationship's first set of components is the union of the first set of components of said first and second requires choice relationships and said new relationship's second set of components is the difference of the second set of components of said first and second requires choice relationship.

46. The method of claim **39** wherein a type of said internal relationships is an includes relationship, said includes relationship identifies a second set of components that are included in said system when all of a first set of components exist in said system, said step of translating further comprises the steps of:

determining whether the second set of components of an includes relationship are contained in a first set of components of another internal relationship;

replacing said second set of components of said includes relationship in said another internal relationship with said first set of components of said includes relationship when said second set of components of an includes relationship are contained in a first set of components of another internal relationship.

47. The method of claim **39** said internal representation comprises multiple types of relationships, each type of relationship having a first and second set of components and an operation, said operation is performed on said second set of components when said first set of components exist in said system.

48. The method of claim **47** wherein said step of translating further comprises the steps of:

determining whether a first and second relationship are the same type of relationship;

performing the following steps when they are the same type:

determining whether the first relationship's first set of components is a proper subset of the second relationship's first set of components;

removing the first relationship's second set of components that exist from the second relationship's second set of components when said proper subset exists;

removing said second relationship when said second relationship's second set of components is an empty set.

49. The method of claim **47** wherein said step of validating further comprises the steps of:

determining whether a component selected by said configuration input is selectable; and

invalidating said configuration input when said component is not selectable.

50. The method of claim **49** wherein said one of said internal relationships is an includes relationship, said includes relationship causing a second set of components to be included in said system when all members of a first set of components exist in said system, said second step of determining further comprises the step of:

determining whether any member of the second set of components cannot be included in said system.

51. The method of claim **49** wherein said one of said internal relationships is an excludes relationship, said excludes relationship causing a second set of components to be excluded from said system when all members of a first set of components exist in said system, said second step of determining further comprises the step of:

determining whether any member of the second set of components already exists in said system.

52. The method of claim **49** wherein said one of said internal relationships is an removes relationship, said removes relationship causing a second set of components to be removed from said system when all members of a first set of components exist in said system, said second step of determining further comprises the step of:

determining whether any member of the second set of components has been selected for inclusion in said system by a configuration user.

53. The method of claim **49** wherein said one of said internal relationships is a requires choice relationship, said requires choice relationship requiring a selection of a number of members of a second set of components when all members of a first set of components exist in said system, said second step of determining further comprises the step of:

determining whether said number of members of said second set of components cannot be selected for addition to said system.

54. The method of claim **47** wherein said step of modifying further comprises the steps of:

determining whether the performance of said operation of one of said internal relationships would result in an invalid configuration;

causing said one of said internal relationships to become inactivateable.

55. The method of claim **54** wherein said step of causing further comprises the step of excluding the last remaining member of said first set of components such that said last remaining member cannot be added to said system, said last remaining member being the only member of said first set of components that has not already been selected.

56. The method of claim **39** wherein said step of translating further comprises the step of:

mapping said intuitive relationships of said external representation into a set of relationships in said internal representation.

57. The method of claim **39** wherein said internal representation is stored as a set of bit vectors wherein each bit vector includes a bit that corresponds to one of said components of said system definition, the impact of changing the number of said components of said system definition thereby being minimal.

58. The method of claim **57** wherein said step of validating comprising a plurality of bit-level operations.

59. The method of claim **39** wherein said step of modifying further comprises the step of updating said configuration state to represent which of said components of said system definition are selectable, selected, included, and excluded.

60. A method of configuring a system comprising the steps of:

generating a definition for said system, said definition containing one or more elements and being conveyed graphically using a set of product relationships;

generating a set of part relationships between said one or more elements, said set of part relationships being conveyed graphically using a set of part relationships; and

receiving input from a configuration user;

validating said input based on said definition, said set of product relationships, said set of part relationships, and a current configuration state; and

identifying a set of valid configuration options using said definition, said set of product relationships, said set of part relationships and said current configuration state.

61. The method of claim **60** wherein said step of identifying further comprises the steps of:

determining whether a relationship in said set of relationships is active;

modifying said configuration to satisfy said active relationship when it is determined that a modification is needed;

making said relationship notActivateable when it is determined that said relationship is not active and the activation of said relationship would render the configuration invalid.

62. The method of claim **61** wherein said step of determining whether a relationship is active further comprises the step of determining whether the elements specified in the left-hand side of said relationship are present in said configuration.

63. The method of claim **62** wherein said step of determining whether the elements specified in the left-hand side of said relationship are present in said configuration further comprises the step of performing a bit-level comparison of the bits corresponding to the elements in said left-hand side of the relationship with a "selected" bit vector.

64. The method of claim **61** wherein said relationship is an includes relationship, said step of modifying further comprises the step of including in said configuration elements identified in a right-hand side of said relationship.

65. The method of claim **61** wherein said relationship is an excludes relationship, said step of modifying further comprises the step of marking said elements identified in the right-hand side of said relationship as excluded and notSelectable.

66. The method of claim **61** wherein said relationship is a removes relationship, said step of modifying further comprises the step of removing said elements identified in the right-hand side of said relationship from said configuration.

67. The method of claim **61** wherein said relationship is a requires choice relationship, said step of modifying further comprises the steps of:

determining whether a plurality of elements identified in a right-hand side of said relationship are present in said configuration such that said relationship is satisfied;

modifying said configuration to satisfy said requires choice relationship when it is determined that only one path exists to satisfy said relationship and said relationship is not already satisfied.

68. The method of claim **61** wherein said step of making said relationship notActivateable further comprises the step of marking one or more elements in said left-hand side of said relationship as notSelectable.

69. The method of claim **60** wherein said definition, each of said set of relationships, and said current configuration state are expressed as bit vectors having bits that correspond to elements.

70. The method of claim **60** wherein said step of validating further comprises the step of determining whether the relationships other than those marked notActivateable in said set of relationships can be satisfied.

71. The method of claim **60** wherein said step of generating a definition selects said one or more elements for inclusion in said definition, said input is made without regard for the order in which said one or more elements are selected for said definition.

72. The method of claim **60** wherein said configuration state identifies a set of selected elements and a set of selectable elements for said system, said input capable of selecting any member of said set of selectable elements and being made despite the order in which members of said set of selected elements were selected.

73. An article of manufacture comprising:

a computer usable medium having computer readable program code embodied therein for configuring a system comprising:

computer readable program code configured to cause a computer to generate a definition for said system, said definition containing one or more elements and being conveyed graphically using a set of product relationships;

computer readable program code configured to cause a computer to generate a set of part relationships between said one or more elements, said set of part relationships being conveyed graphically using a set of part relationships; and

computer readable program code configured to cause a computer to receive input from a configuration user;

computer readable program code configured to cause a computer to validate said input based on said definition, said set of product relationships, said set of part relationships, and a current configuration state; and

computer readable program code configured to cause a computer to identify a set of valid configuration options using said definition, said set of product relationships, said set of part relationships and said current configuration state.

74. The article of manufacture of claim **73** wherein said computer readable program code configured to cause a computer to identify further comprises:

computer readable program code configured to cause a computer to determine whether a relationship in said set of relationships is active;

computer readable program code configured to cause a computer to modify said configuration to satisfy said active relationship when it is determined that a modification is needed;

computer readable program code configured to cause a computer to make said relationship notActivateable when it is determined that said relationship is not active and the activation of said relationship would render the configuration invalid.

75. The article of manufacture of claim **74** wherein said computer readable program code configured to cause a computer to determine whether a relationship is active further comprises computer readable program code configured to cause a computer to determine whether the elements specified in the left-hand side of said relationship are present in said configuration.

76. The article of manufacture of claim **75** wherein said computer readable program code configured to cause a computer to determine whether the elements specified in the left-hand side of said relationship are present in said configuration further comprises computer readable program code configured to cause a computer to perform a bit-level

comparison of the bits corresponding to the elements in said left-hand side of the relationship with a "selected" bit-vector.

77. The article of manufacture of claim 74 wherein said relationship is an includes relationship, said computer readable program code configured to cause a computer to modify further comprises computer readable program code configured to cause a computer to include in said configuration elements identified in a right-hand side of said relationship.

78. The article of manufacture of claim 74 wherein said relationship is an excludes relationship, said computer readable program code configuredto cause a computer to modify further comprises computer readable program code configured to cause a computer to mark said elements identified in the right-hand side of said relationship as excluded and notSelectable.

79. The article of manufacture of claim 74 wherein said relationship is a removes relationship, said computer readable program code configured to cause a computer to modify further comprises computer readable program code configured to cause a computer to remove said elements identified in the right-hand side of said relationship from said configuration.

80. The article of manufacture of claim 74 wherein said relationship is a requires choice relationship, said computer readable program code configured to cause a computer to modify further comprises:

computer readable program code configured to cause a computer to determine whether a plurality of elements identified in a right-hand side of said relationship are present in said configuration such that said relationship is satisfied;

computer readable program code configured to cause a computer to modify said configuration to satisfy said requires choice relationship when it is determined that only one path exists to satisfy said relationship and said relationship is not already satisfied.

81. The article of manufacture of claim 74 wherein said computer readable program code configured to cause a computer to make said relationship notActivateable further comprises computer readable program code configured to cause a computer to mark one or more elements in said left-hand side of said relationship as notSelectable.

82. The article of manufacture of claim 73 wherein said definition, each of said set of relationships, and said current configuration state are expressed as bit vectors having bits that correspond to elements.

83. The article of manufacture of claim 73 wherein said code configured to cause a computer to validate further comprises program code configured to cause a computer to determine whether the relationships other than those marked notActivateable in said set of relationships can be satisfied.

84. The article of manufacture of claim 73 wherein said code configured to cause a computer to generate a definition selects said one or more elements for inclusion in said definition, said input is made without regard for the order in which said one ore more elements are selected for said definition.

85. The article of manufacture of claim 73 wherein said configuration state identifies a set of selected elements and a set of selectable elements for said system, said input capable of selecting any member of said set of selectable elements and being made despite the order in which members of said set of selected elements were selected.

* * * * *

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United States Patent [19]

Maritzen et al.

[11] Patent Number: 5,870,719

[45] Date of Patent: *Feb. 9, 1999

[54] **PLATFORM-INDEPENDENT, USAGE-INDEPENDENT, AND ACCESS-INDEPENDENT DISTRIBUTED QUOTE CONFIGURATON SYSTEM**

[75] Inventors: **L.M. Maritzen; Rolando D. Dimaandal**, both of Milpitas; **Julia Giannella**, Saratoga; **Raul Arregui**, Pacifica; **Marc Moss**, Fremont, all of Calif.

[73] Assignee: **Sun Microsystems, Inc.**, Mountain View, Calif.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **675,683**

[22] Filed: **Jul. 3, 1996**

[51] **Int. Cl.**[6] **G06F 17/60**

[52] **U.S. Cl.** **705/26**; 345/329; 345/333; 345/334; 345/335; 364/400; 395/200.33; 395/200.47; 395/200.49; 395/200.6; 705/35; 707/104

[58] **Field of Search** 364/400, 464.1, 364/479.01, 479.02, 479.04, 479.06; 395/200.6, 200.33, 200.47, 200.48, 200.49, 201, 226, 227, 329, 330, 331, 333, 334, 335; 705/1, 26, 27, 400, 35; 345/329, 330, 331, 333, 334, 335; 707/104

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,314,049	4/1967	Felcheck	705/15
4,473,824	9/1984	Claytor	340/825.27
5,331,543	7/1994	Yajima et al.	705/31
5,357,439	10/1994	Matsuzaki et al.	364/468.02
5,570,291	10/1996	Dudle et al.	364/468.01
5,666,493	9/1997	Wojcik et al.	705/26
5,694,546	12/1997	Reisman	395/200.9
5,710,887	1/1998	Chelliah et al.	395/226

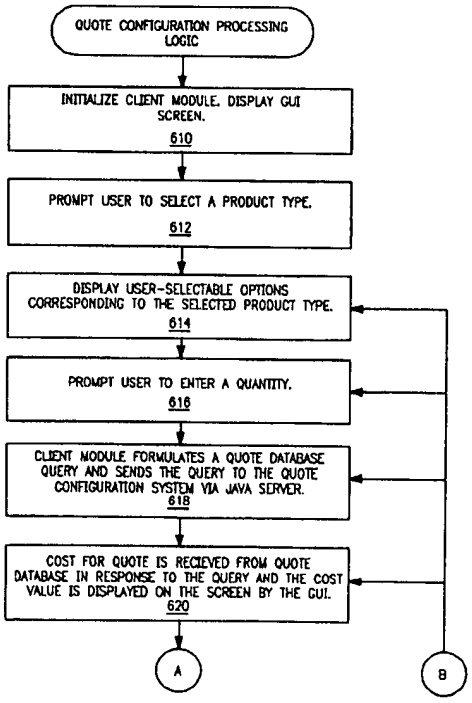
Primary Examiner—Edward R. Cosimano

Attorney, Agent, or Firm—Blakely Sokoloff Taylor & Zafman

[57] **ABSTRACT**

A platform-independent, usage-independent, location-independent quote configuration system is described. The present invention, operating in a computer network, is a quote configurator comprising, 1) a client module, the client module having a platform-independent user interface for receiving quote input and command selections from a user, the quote input and command selections including product selection and selection of information indicative of business rules, and 2) a server coupled to the client module across the network, the server having access to quote data and business rules, the server including a platform-independent server interface configured to receive the quote input and command selections from the client module, the server validating the quote input based on the quote data and the business rules.

24 Claims, 7 Drawing Sheets



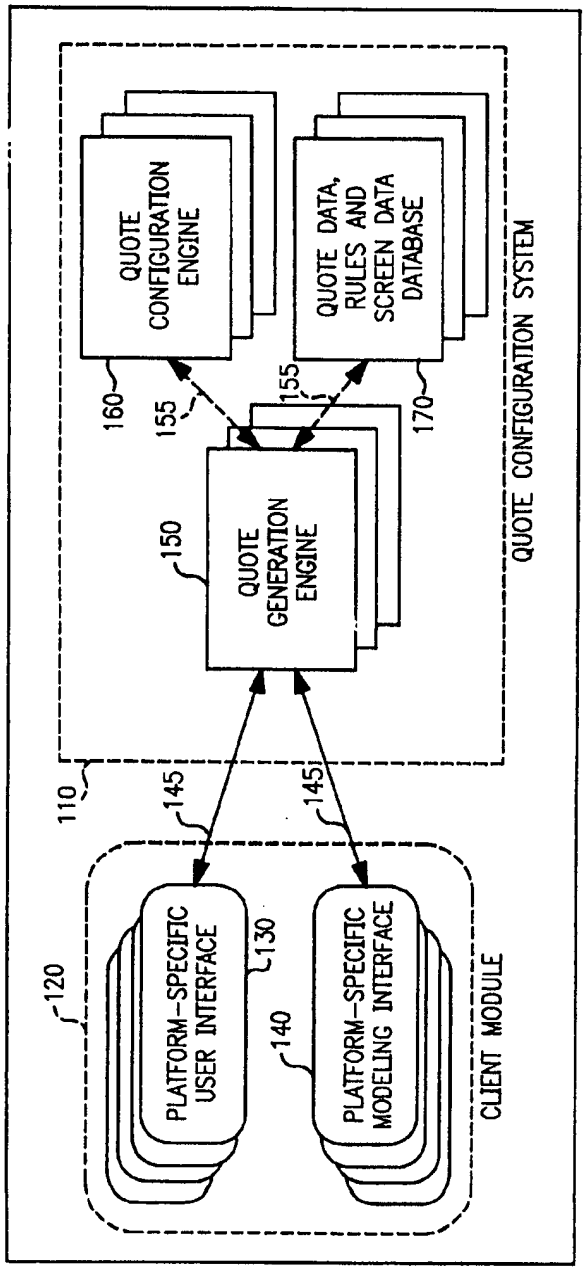


FIG. 1
PRIOR ART

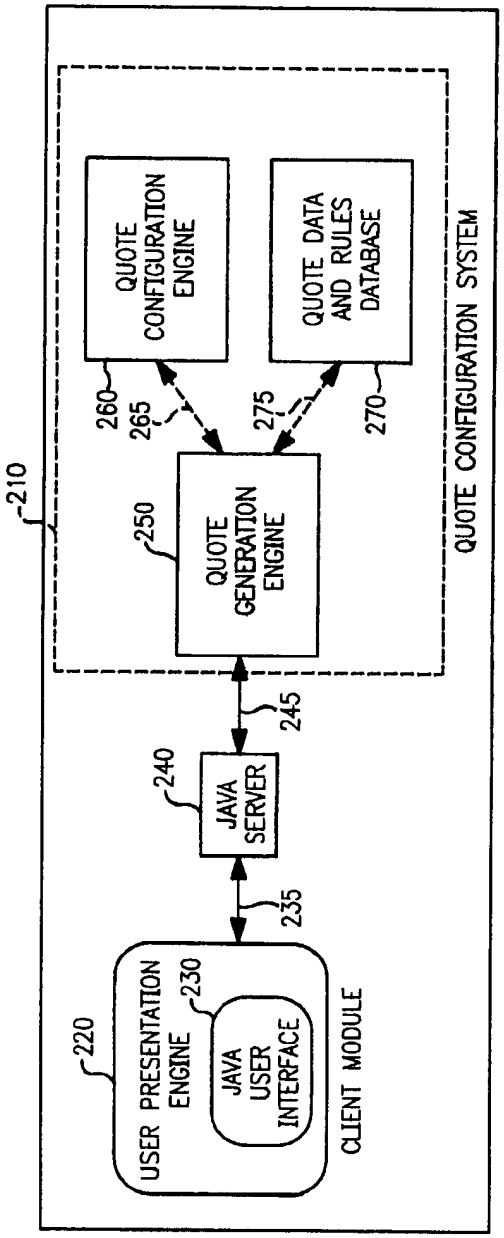

QUOTE CONFIGURATION SYSTEM
QUOTE CONFIGURATION ENGINE
QUOTE DATA AND RULES DATABASE
QUOTE GENERATION ENGINE
JAVA SERVER
USER PRESENTATION ENGINE
JAVA USER INTERFACE
CLIENT MODULE
210
220
230
235
240
245
250
260
265
270
275

FIG. 2

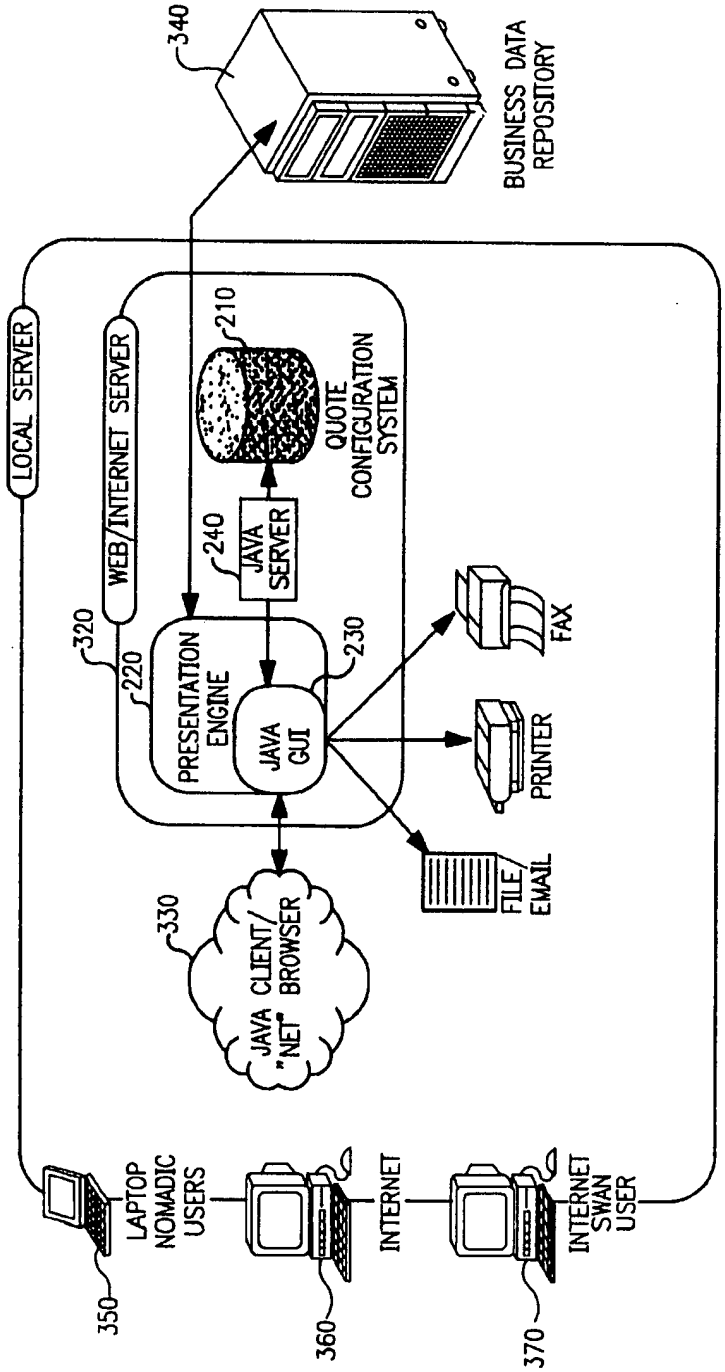

340
BUSINESS DATA REPOSITORY
LOCAL SERVER
WEB/INTERNET SERVER
210
QUOTE CONFIGURATION SYSTEM
240
JAVA SERVER
320
220
PRESENTATION ENGINE
230
JAVA GUI
FAX
PRINTER
FILE/ EMAIL
330
JAVA CLIENT/ "NET" BROWSER
LAPTOP NOMADIC USERS
INTERNET
INTERNET SWAN USER
350
360
370

FIG. 3

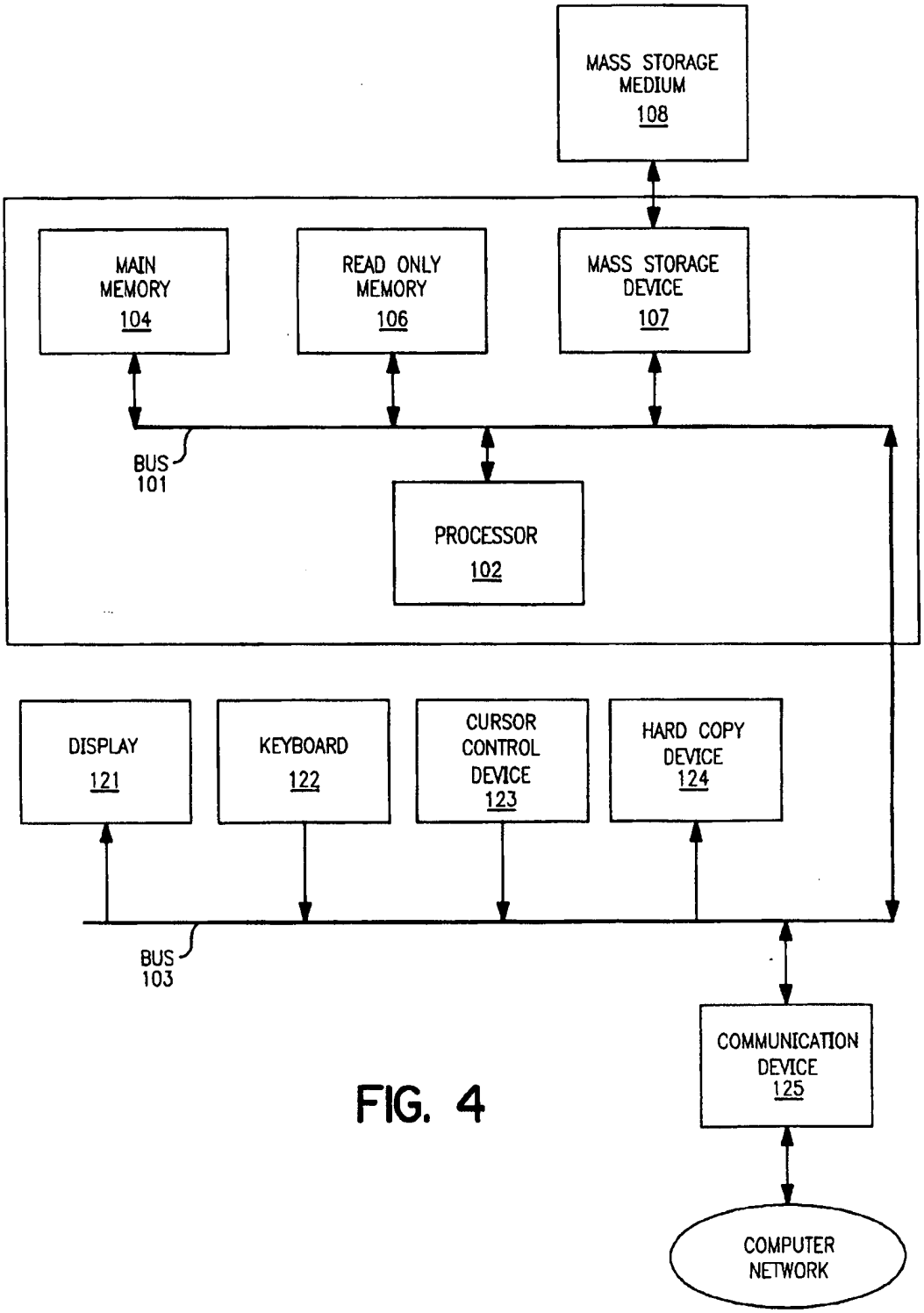

MASS STORAGE MEDIUM
108
MAIN MEMORY
104
READ ONLY MEMORY
106
MASS STORAGE DEVICE
107
BUS
101
PROCESSOR
102
DISPLAY
121
KEYBOARD
122
CURSOR CONTROL DEVICE
123
HARD COPY DEVICE
124
BUS
103
COMMUNICATION DEVICE
125
COMPUTER NETWORK

FIG. 4

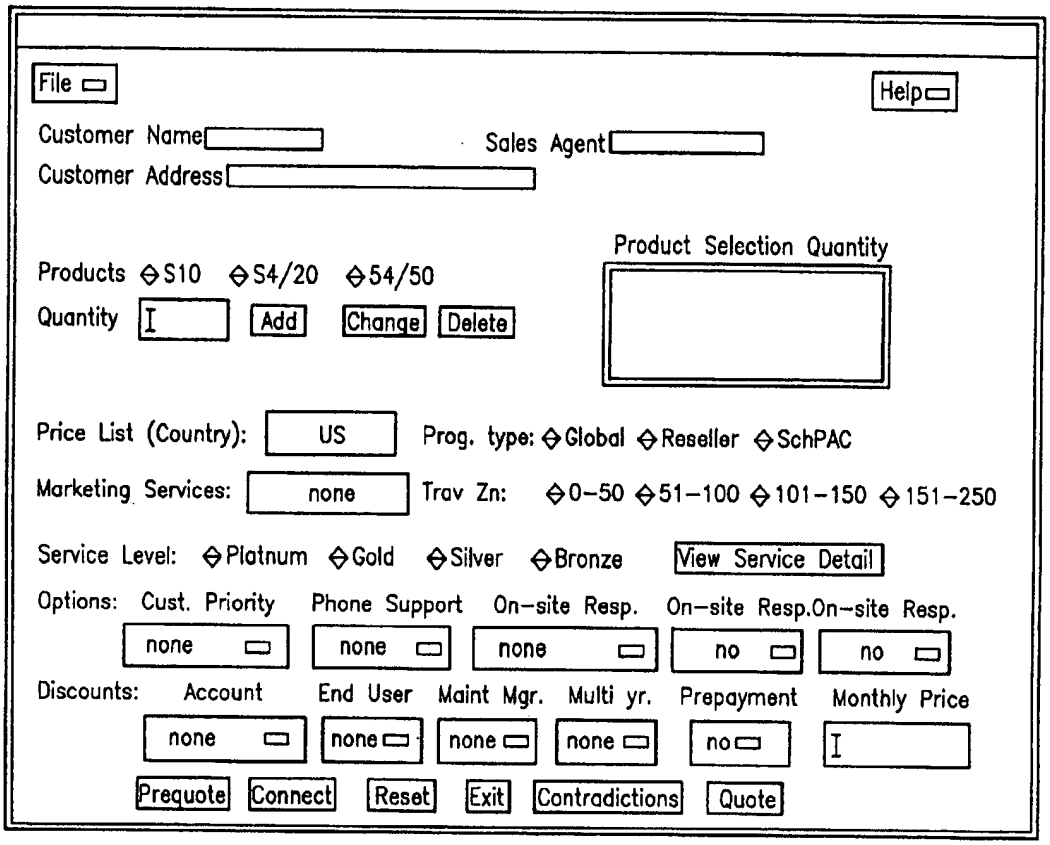

File
Help
Customer Name
Sales Agent
Customer Address
Product Selection Quantity
Products S10 S4/20 54/50
Quantity
Add
Change
Delete
Price List (Country):
US
Prog. type: Global Reseller SchPAC
Marketing Services:
none
Trav Zn: 0-50 51-100 101-150 151-250
Service Level: Platnum Gold Silver Bronze
View Service Detail
Options: Cust. Priority Phone Support On-site Resp. On-site Resp. On-site Resp.
none
none
none
no
no
Discounts: Account End User Maint Mgr. Multi yr. Prepayment Monthly Price
none
none
none
none
no
Prequote
Connect
Reset
Exit
Contradictions
Quote

FIG. 5

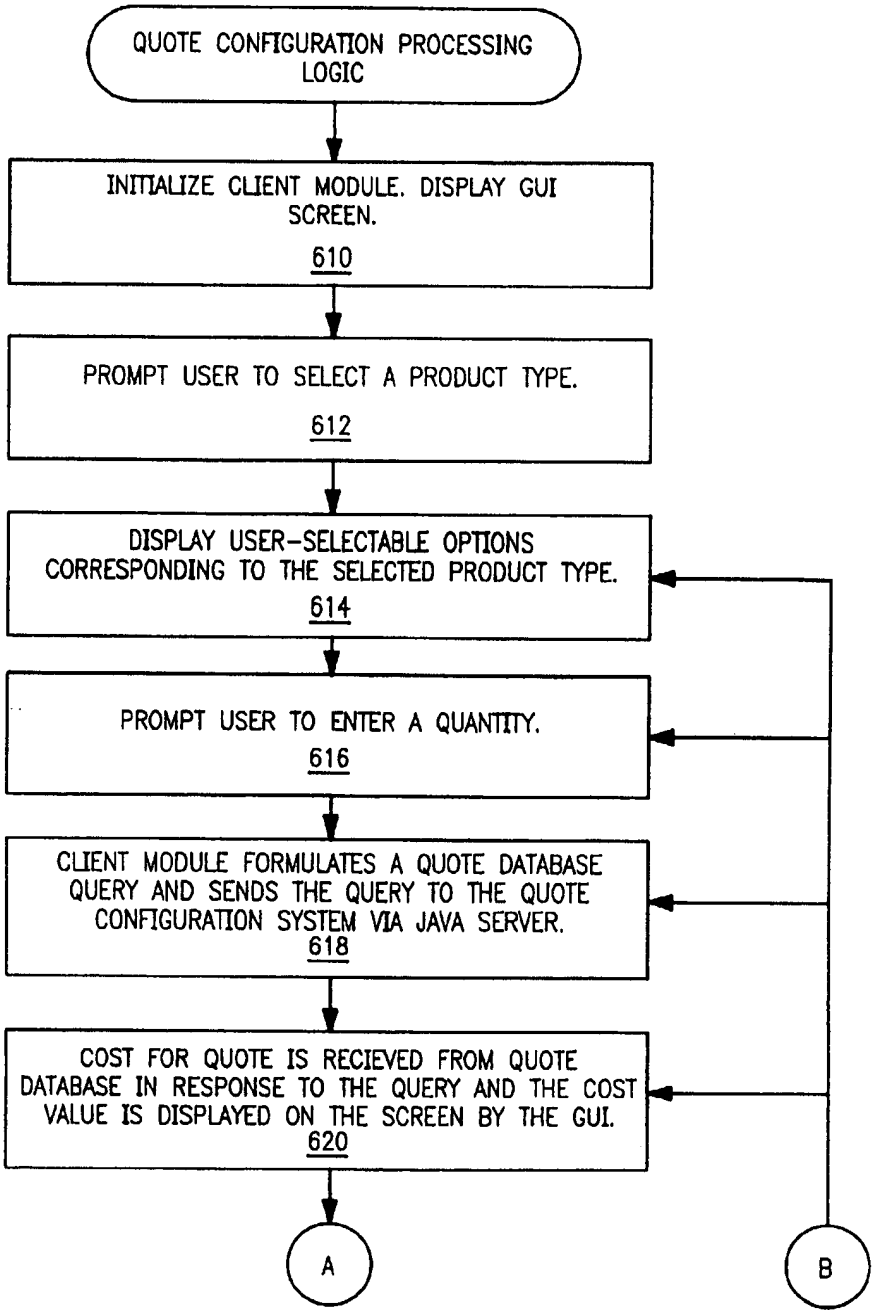

QUOTE CONFIGURATION PROCESSING LOGIC
INITIALIZE CLIENT MODULE. DISPLAY GUI SCREEN.
610
PROMPT USER TO SELECT A PRODUCT TYPE.
612
DISPLAY USER-SELECTABLE OPTIONS CORRESPONDING TO THE SELECTED PRODUCT TYPE.
614
PROMPT USER TO ENTER A QUANTITY.
616
CLIENT MODULE FORMULATES A QUOTE DATABASE QUERY AND SENDS THE QUERY TO THE QUOTE CONFIGURATION SYSTEM VIA JAVA SERVER.
618
COST FOR QUOTE IS RECIEVED FROM QUOTE DATABASE IN RESPONSE TO THE QUERY AND THE COST VALUE IS DISPLAYED ON THE SCREEN BY THE GUI.
620
A
B

FIG. 6

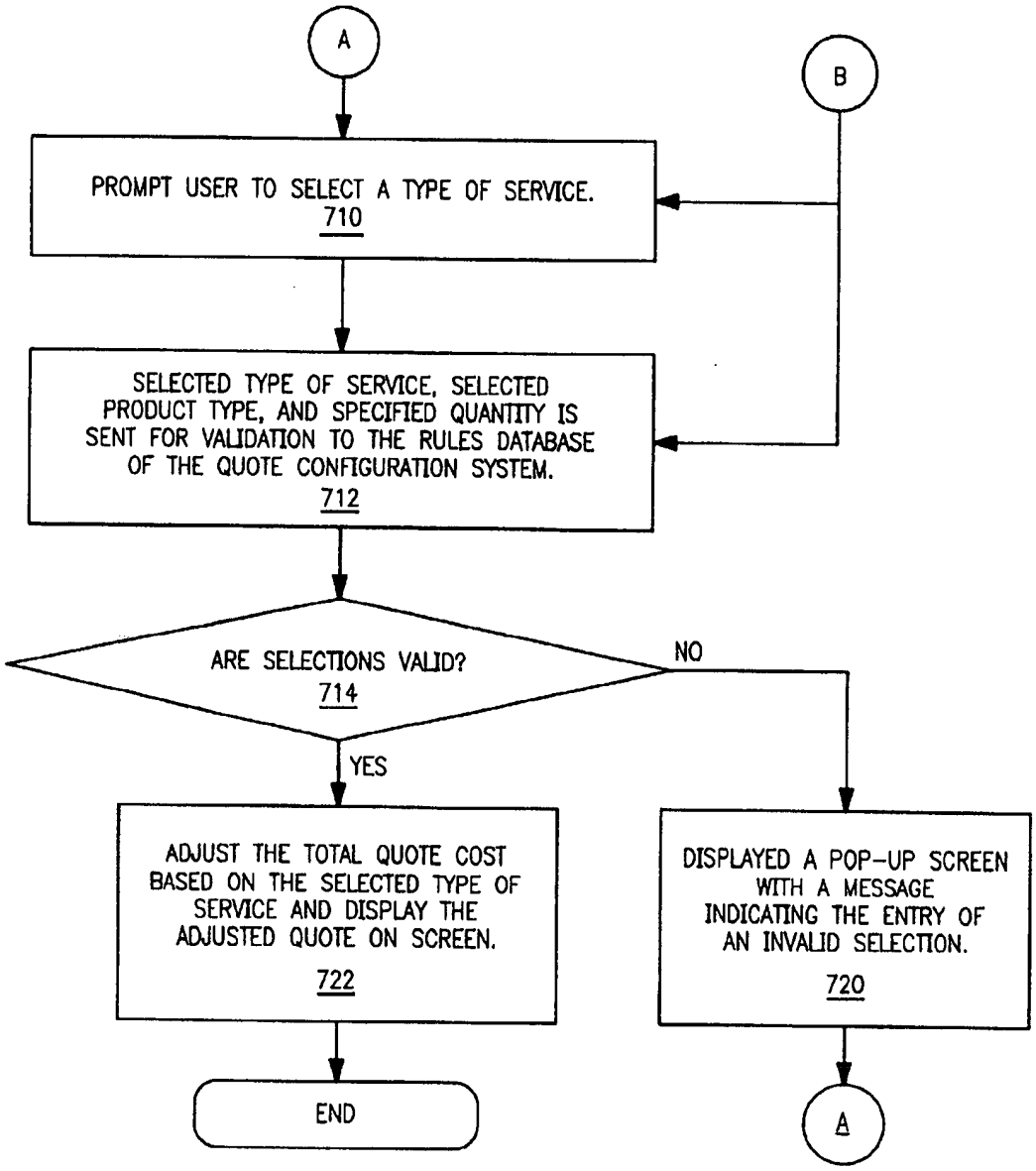

A
B
PROMPT USER TO SELECT A TYPE OF SERVICE.
710
SELECTED TYPE OF SERVICE, SELECTED PRODUCT TYPE, AND SPECIFIED QUANTITY IS SENT FOR VALIDATION TO THE RULES DATABASE OF THE QUOTE CONFIGURATION SYSTEM.
712
ARE SELECTIONS VALID?
714
NO
YES
ADJUST THE TOTAL QUOTE COST BASED ON THE SELECTED TYPE OF SERVICE AND DISPLAY THE ADJUSTED QUOTE ON SCREEN.
722
DISPLAYED A POP-UP SCREEN WITH A MESSAGE INDICATING THE ENTRY OF AN INVALID SELECTION.
720
END
A

FIG. 7

PLATFORM-INDEPENDENT, USAGE-INDEPENDENT, AND ACCESS-INDEPENDENT DISTRIBUTED QUOTE CONFIGURATON SYSTEM

FIELD OF THE INVENTION

The present invention relates to the field of distributed computer systems. Specifically, the present invention relates to the field of distributed computer systems for configuring and providing pricing and quotation information regardless of usage or access model and independent of platform type.

BACKGROUND OF THE INVENTION

Pricing and quotation information is produced at different points and different geographic locations in the sales process. Some of the key triggers used to produce this information include product sales, volume discounts, warranty terms, sales/lease contract terms, contract renewals or modifications, or special customer requests. Often times, quotations or quotes produced as a result of these triggers vary substantially based on the business unit or geographic location for which a particular quote is targeted. These variations are also caused by the different computer platforms, systems, usage models and networks used to assemble the quote information. Variations can also be caused by lack of, or differing, in-depth knowledge of the specific business rules and discounts that apply to each scenario, location, and business unit. In some cases, duplicate and redundant information must be reformatted or translated to a form compatible with a component of the quote generation system. In other cases, information must be manually entered. This is due in large part to the rigid data input requirements of conventional quote configuration systems.

The limitations in current quote configuration systems result in quotes that are difficult to generate and maintain, which contain errors that impact the customer and the business units, and require manual entry of redundant information at each step of the process.

Thus, a platform-independent, usage-independent, location-independent quote configuration systems which is capable of encapsulating the business logic and business unit expertise to produce consistent, accurate results is needed.

SUMMARY OF THE INVENTION

A platform-independent, usage-independent, location-independent quote configuration system is described. The present invention, operating in a computer network, is a quote configurator comprising, 1) a client module, the client module having a platform-independent user interface for receiving quote input and command selections from a user, the quote input and command selections including product selection and selection of information indicative of business rules, and 2) a server coupled to the client module across the network, the server having access to quote data and business rules, the server including a platform-independent server interface configured to receive the quote input and command selections from the client module, the server validating the quote input based on the quote data and the business rules.

Thus, it is an advantage of the present invention over conventional systems that the present invention is based on a non-procedural data-driven work flow design. It is a further advantage of the present invention that the point of service provides a real-time, interactive model for interaction on all components with the user. It is a further advantage of the present invention that all business rules and expertise needed to provide intelligent quoting are encapsulated within the quote configuration system, and are transferable and usable anywhere on any platform. This enables the design to be scalable with localization possible to accommodate variations in attributes such as currency and price list. It is a further advantage of the present invention that the present invention is based on an open architecture to enable integration with other systems, business processes and technologies. It is a further advantage of the present invention that the present invention is platform-independent (ex. SPARC™, RISC, X86). It is a further advantage of the present invention that the present invention is independent of usage model (ex. nomadic, remote/dial-up, inter-networked, intra-networked). It is a further advantage of the present invention that the present invention is independent of access model (ex. stand-alone application, networked application, web-based application, web-based applet).

The features and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description of the preferred embodiment of the present invention as set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the accompanying drawings, in which:

FIG. **1** illustrates the system architecture of a prior art quote configuration system.

FIG. **2** illustrates the architecture of the quote configurator of the preferred embodiment of the present invention.

FIG. **3** illustrates the operation of the quote configurator of the preferred embodiment of the present invention.

FIG. **4** illustrates a typical data processing system or platform upon which one embodiment of the present invention is implemented.

FIG. **5** illustrates a sample screen display of the graphical user interface of the preferred embodiment.

FIGS. **6** and **7** are flowcharts illustrating the operation of the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is a platform-independent, usage-independent, location-independent quote configuration system. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one of ordinary skill in the art that these specific details need not be used to practice the present invention. In other instances, well-known structures, interfaces and processes have not been shown in detail in order not to unnecessarily obscure the present invention.

FIG. **4** illustrates a typical data processing system or platform upon which one embodiment of the present invention is implemented. It will be apparent to those of ordinary skill in the art, however that other alternative systems of various system architectures may also be used. The data processing system illustrated in FIG. **4** includes a bus or other internal communication means **101** for communicating information, and a processor **102** coupled to the bus **101** for processing information. The system further comprises a random access memory (RAM) or other volatile storage device **104** (referred to as main memory), coupled to bus **101** for storing information and instructions to be executed by processor **102**. Main memory **104** also may be used for

storing temporary variables or other intermediate information during execution of instructions by processor **102**. The system also comprises a read only memory (ROM) and/or static storage device **106** coupled to bus **101** for storing static information and instructions for processor **102**, and a data mass storage device **107** such as a magnetic disk drive or optical disk drive. Data storage device **107** is coupled to bus **101** and is typically used with a computer readable mass storage medium **108**, such as a magnetic or optical disk, for storage of information and instructions. The system may further be coupled to a display device **121**, such as a cathode ray tube (CRT) or a liquid crystal display (LCD) coupled to bus **101** through bus **103** for displaying information to a computer user. An alphanumeric input device **122**, including alphanumeric and other keys, may also be coupled to bus **101** through bus **103** for communicating information and command selections to processor **102**. An additional user input device is cursor control **123**, such as a mouse, a trackball, stylus, or cursor direction keys coupled to bus **101** through bus **103** for communicating direction information and command selections to processor **102**, and for controlling cursor movement on display device **121**. Another device which may optionally be coupled to bus **101** through bus **103** is a hard copy device **124** which may be used for printing instructions, data, or other information on a medium such as paper, film, or similar types of media. In the preferred embodiment, a communication device **125** is coupled to bus **101** through bus **103** for use in accessing other nodes of a network computer system. This communication device **125** may include any of a number of commercially available networking peripheral devices such as those used for coupling to an Ethernet, token ring, Internet, or wide area network.

Note that any or all of the components of the system illustrated in FIG. **4** and associated hardware may be used in various embodiments of the present invention; however, it will be appreciated by those of ordinary skill in the art that any configuration of the system may be used for various purposes according to the particular implementation. In one embodiment of the present invention, the data processing system illustrated in FIG. **4** is an IBM® compatible personal computer (PC) or a SUN® SPARC™ Workstation. Processor **102** may be one of the 80X86 compatible microprocessors such as the 80486 or PENTIUM® brand microprocessors manufactured by INTEL® Corporation of Santa Clara, Calif.

The software implementing the present invention can be stored in main memory **104**, mass storage device **107**, or other storage medium locally accessible to processor **102**. It will be apparent to those of ordinary skill in the art that the methods and processes described herein can be implemented as software stored in main memory **104** or read only memory **106** and executed by processor **102**. This software may also be resident on an article of manufacture comprising a computer usable mass storage medium **108** having computer readable program code embodied therein and being readable by the mass storage device **107** and for causing the processor **102** to perform quote transactions and protocols in accordance with the teachings herein.

The preferred embodiment of the present invention is a platform-independent, usage-independent, location-independent quote configuration system, which can be implemented on computer system platforms such as the one illustrated in FIG. **4**.

ARCHITECTURE OF THE PREFERRED EMBODIMENT

FIG. **1** illustrates the typical quote configuration generation system currently used in the prior art. The architecture of a typical conventional quote processing system is based on a two-tier procedural model with deliberate data synchronization latency. The client module **120** is typically large, requiring significant local client resources (such as disk space, memory, swap space, etc.) to run the quote configuration system. The client module **120** includes a platform-specific modeling interface **140** and a platform-specific user interface **130**. The client module **120** is coupled to a conventional quote configuration system **110** across a network connection using a transaction messaging mechanism **145**, which is compatible with a conventional quote generation engine **150** in quote configuration system **110**. Quote generation engine **150** is then coupled to quote configuration engine **160** and quote database **170** across an interface using an intrasystem communication protocol **155**. Quote database **170** provides the quote data, rules, and screen data used by the quote generation engine **150** along with quote configuration engine **160** to generate a quote. Multiple configuration system databases are deployed to accommodate location-specific variables.

This prior art quote configuration methodology has several disadvantages, which are listed below:

1. A different platform-specific user interface **130** and client module **120** is necessary for each type of hardware architecture and operating system (OS) (i.e. platform) upon which the quote configuration system is deployed.

2. A different platform-specific user interface **130**, client module **120**, transaction messaging mechanism **145**, and intrasystem communication protocol **155** is necessary for each type of usage model for which the quote configuration system is implemented. In conventional systems, the four usage models commonly utilized are nomadic, remote/dial-up, inter-networked and intra-networked. In a nomadic system, the client module is resident in a portable computer system, which only periodically and asynchronously connects to the quote configuration system. In a remote/dial-up model, the client module uses a dial-up modem protocol to asynchronously connect with the quote configuration system **110**. In an inter-networked model, the client module uses Internet or World Wide Web (WWW) protocols to synchronously but indirectly connect to a quote configuration system. In an intra-networked model, the client module uses local area network (LAN) or wide-area network (WAN) protocols to synchronously and directly connect to a quote configuration system.

3. A different platform-specific user interface **130**, client module **120**, transaction messaging mechanism and intra-system communication protocol is necessary for each type of access model for which the quote configuration system is implemented. The four access models commonly provided in conventional systems are stand-alone application, networked application, web-based application and web-based applet. Stand-alone applications are those software systems that run on a platform without network connectivity. Networked applications are those software systems that run on a platform with network connectivity and involve network transactions. The web-based models run on the World Wide Web (WWW) portion of the Internet and have dependencies on browser-specific implementations in addition to platform-specific dependencies. All four of these prior art access models have user interface screen rendering logic and data which is tightly integrated with the business rules and quote data in the quote configuration system **110**.

4. The system architecture and application programming interfaces (APIs) are proprietary and closed.

5. The work flow design is strictly procedural in a batch style of processing and has deliberate latency built into the data synchronization model.

6. Distribution of the quote configuration system and client software, synchronization of quote data and business rules, and version control of the system are difficult to manage effectively.

7. A different quote configuration engine **160** and quote database **170** must be deployed to accommodate each location-specific environment.

8. The user interface **130** requires extensive knowledge of the underlying business rules and quote data to generate a configuration quote.

9. The prior art design is based on a two-tiered, non-distributed/non-networked model.

FIG. **2** illustrates the quote configurator of the preferred embodiment of the present invention. In the present invention all common configurations and usage models are enabled by a single architecture and single user interface model, including mobile computing devices (nomadics and remote access/dial-ups), local area networks (LANs), wide area networks (WANs) and the Internet network. In general, these components provide specific functionality for handling quotation information and for generating quotes.

The architecture of the present invention is based on a distributed three-tier object-oriented design model as shown in FIG. 2. A first tier is a client module **220**. The second tier is a server **240** and the third tier is quote configuration system **210**.

The client module **220** includes a JAVA™ user interface **230**. JAVA is an object-oriented programming language similar to C++ developed by SUN® Microsystems of Mountain View, Calif. JAVA is unique in that a program written in JAVA is first compiled into byte-codes and subsequently interpreted into machine dependent processor instructions. Byte-codes are similar to machine instructions; however, byte-codes are not specific to a particular machine or platform. Thus, JAVA programs can run on any platform that supports JAVA. It is not necessary to recompile a JAVA program to run on a new machine. The JAVA user interface **230** may therefore be written without platform-specific code and without the need to create multiple versions that support multiple platforms.

Each tier of the system illustrated in FIG. **2** encapsulates all the necessary components for the intended function. All interfaces of the present invention are open and public. The messaging transport system of the present invention is based on socket-level communication protocol using open APIs at each end of the communications path, such as paths **235** and **245**. Socket-level communication protocol in the context of a computer network is well known to those of ordinary skill in the art. The user presentation engine of client module **220**, user interface **230**, and JAVA server **240** components are platform-independent, usage-independent, and access-independent and based on a single code source. The JAVA server **240** API which interfaces path **245** to quote generation engine **250** is an essential element of the present invention. Similarly, the JAVA server **240** API which interfaces path **235** to client module **220** is also an essential element of the present invention. Specifically, the user interface component **230** is a graphical user interface (GUI) and looks and operates in exactly the same manner independently of platform, usage, and access model. The GUI **230** is fully interactive and intelligent, and requires absolutely no knowledge of the underlying business rules and quote data for a user to generate an accurate configuration quote. The interaction of the GUI **230** is field-based, data-driven and event-driven. The quote data and rules database **270** also contains new components to support the present invention.

The client module **220** API to quote generation engine **250** through JAVA server **240** comprises commands, which are formulated in a platform-independent text string format and sent to quote generation engine **250** via a socket interface of JAVA server **240**. A specified port number is used by both the client module **220** and the quote generation engine **250**. The quote generation engine **250** interprets these commands and sends back its replies to the client module **220** via the socket interface of JAVA server **240**. A detailed description of the commands of this API follows.

Commands

bload rtssun7b.cab

This command makes the quote generation engine **250** read and load (in memory) all information contained in the rtssun7b.cab file. This file contains all business rules and screen rendering information needed by the quote generation engine **250**.

BEruntimeInit streamout

This command initiates runtime a communication protocol by the quote generation engine **250**. The 'streamout' argument is a parameter that tells the quote generation engine **250** to use its socket layer interface for communication.

BEinsPickByIndex <field> <idx> 1

This command instructs the quote generation engine **250** to pick a <field> with index <idx> and return all information stored for this field. The <field> argument can be any of the following in the preferred embodiment:

Contract	PriceBook	MarketingServices
ReplcHrdwrPrts	CstDefPrty	UnlimPhoneSprt
OnSiteResp	OnSiteResp2_hr	OnSiteCov7_24
PrefCustomer	EndUser	MaintMan
Multiyr		

The <indx> argument is an integer value representing the index of the specified field.

Example: BEinsPickByIndex Contract 2 1

(This sample command requests the quote generation engine **250** to retrieve all the information about the second field for contracts.)

BEinsValueSet NumberUsers val val <qty>

This command sets the quantity of products specified by the user. The <qty> argument is an integer value that represents the quantity of products.

BEreset

This command forces the quote generation engine **250** to ignore all previous input and start from the very beginning.

BEprequote

This command produces a pre-quote listing for the current session.

ueQuote

This command produces a final quote for the current session.

BEinsWhy <field> <state>

This command returns an explanation as to why a state of contradiction now exists for this <field>.

Example: BEinsWhy OnSiteResp2_hr 2 (This example asks why is there a contradiction in 2-hr response time?)

BEviewSummaryGet <windowname>

This command returns comprehensive information about a set of fields that logically belong to <windowname>.

Example: BEviewSummaryGet win4 (The quote generation engine **250** returns all current information and states of fields that belong to window 4.)

These interfaces and commands of the preferred embodiment are only a subset of the entire API; however, these commands are sufficient for an operable system. It will be apparent to those of ordinary skill in the art that other commands or command arguments may also be provided. Conversely, the interfaces **265** and **275** to the quote configuration engine **260** and quote database **270**, respectively, are conventional interfaces.

OPERATION OF THE PREFERRED EMBODIMENT

FIG. **3** illustrates the operation of the quote configurator of the preferred embodiment of the present invention. The client module **220** communicates with JAVA server **240** and quote configuration system **210** in the context of the World Wide Web (WWW) and the Internet **320**. The client module **220** may also gather other business data from repository **340**. Network users of the present invention such as nomadic users **350**, Internet users **360**, or intranet users **370** may access the client module **220** of the present invention via JAVA client/net browser **330**. Once these network users connect to the client module **220**, the users may request and view quote information. Quote information may also be printed, faxed, filed, or emailed via output devices connected to client module **220**.

The following sample scenario will demonstrate an example of the quote configuration process of the present invention for generating a custom quote from both the user and system perspective. This example will highlight the essential steps of the present invention as appropriate. In this description, no distinction is made regarding location of the user/system, access method of the user/system, or the type of platform on which either the user or system exists. The same process and model will work regardless of platform, access type, or usage model. FIGS. **2** and **3** are referenced in combination with the flow diagrams of FIGS. **6** and **7** to illustrate the operation of the present invention. In addition, the screen sample shown in FIG. **5** also referenced.

On initiation of the client module **220** of the present invention by the user, the GUI **230** establishes a socket connection with the JAVA server **240** in real-time, and loads an initial data set. In block **610**, shown in FIG. **6**, a main screen or window of the GUI **230** is then auto-populated with a series of default values as specified by the JAVA GUI **230**, based on the encapsulated business rules. One such sample screen is illustrated in FIG. **5**. These default values include Price Lists; Travel Zone; Service Level. At this point in the process, the user only needs to select a product type and enter a quantity in order to receive a quote. In this example, the user will be producing a custom quote.

1. User selects the product.

The user is prompted in block **612**, shown in FIG. **6**, with a pick list to select a product type or the user can ask for additional information/help. On selection of the product type from the pick list presented by the GUI **230**, the GUI **230** logic updates the screen with appropriate user-selectable options, key hints and other information intended to assist the user with creation of the custom quote based on the user selection of product type (block **614**).

2. User enters a quantity.

On entry of the quantity (block **616**), the GUI **230** logic determines the initial total cost for the quote by using the JAVA server **240** and socket protocol via path **245** to query the quote database **270** (block **618**), perform the calculations and update the appropriate portion of the screen of the GUI **230** (block **620**). As denoted by bubble B shown in FIGS. **6** and **7**, the user may iteratively select or edit the selections described in blocks **614–712**.

3. User selects the types of coverage desired.

Referring now to FIG. **7**, selection of the type of coverage provides an adjustment in total quote cost based on the type service selected (blocks **710** and **712** shown in FIG. **7**). This selection of type of coverage identifies a set of business rules which is applied to the request. If this type of coverage is not available for the selected product type and the specified quantity, the business rule of the quote configuration system quote database will indicate an invalid condition which is communicated to the GUI **230** via JAVA server **240** (block **714**). This invalid condition causes a pop-up screen to appear for the user (block **720**). The pop-up screen contains information and navigation/event assistance for the user. These pop-up screens indicating invalid conditions, warnings and hints can be displayed at any time and triggered by any appropriate event; because, the JAVA server **240** and quote configuration system **210** are in frequent communication regarding of the state of the GUI **230** and selected events/options. Also, the user can "override" the suggestion/warning pop-up screen message and proceed with the quote anyway in order to accommodate local variations/conditions.

In addition to event-driven assistance, the user can get on-demand assistance on invalid conditions, additional hints and warnings by selecting the "Contradictions" button as shown on the screen sample shown in FIG. **5**. After the quote is adjusted based on the selected product type, the specified quantity, and type of service, the adjusted quote is displayed for the user on the screen (block **722**). The user can view and process the quote at any time during the configuration process.

The user has the following additional options provided at any time during the quote process in the preferred embodiment: 1) view the quote on-line; 2) fax the quote to a fax-enabled destination using a conventional facsimile device; 3) e-mail the quote to a networked destination using a conventional electronic mail system; 4) print the quote to a system-acknowledged printer; or 5) save the quote to a file. Buttons for selecting these options are shown in FIG. **5** and the interface supporting these options is shown in FIG. **3**.

Thus, a platform-independent, usage-independent, and access-independent quote configuration system has been described. The specific arrangements and methods described herein are merely illustrative of the principles of the present invention. Numerous modifications in form and detail may be made by those of ordinary skill in the art without departing from the scope of the present invention. Although this invention has been shown in relation to a particular embodiment, it should not be considered so limited. Rather, the present invention is limited only by the scope of the following claims.

We claim:

1. In a computer network, a quote configurator comprising:

a client module, the client module having a user interface to receive quote input and command selections from a user, the quote input and command selections including product selection and selection of information indicative of business rules; and

a server coupled to the client module across the network, the server having access to quote data and business rules, the server including a server interface configured to receive the quote input and command selections from the client module, the server validating the quote input based on the quote data and the business rules,

said user interface and said server interface being comprised of platform independent byte-codes.

2. The quote configurator as claimed in claim 1 wherein the server interface is a platform-independent, usage-independent and access-independent transport protocol for messaging quote data and business rules between the server and the client module.

3. The quote configurator as claimed in claim 1 wherein the user interface is a platform-independent, usage-independent and access-independent graphical user interface.

4. The quote configurator as claimed in claim 1 wherein the client module is JAVA compatible.

5. The quote configurator as claimed in claim 1 wherein the server is JAVA compatible.

6. The quote configurator as claimed in claim 1 wherein the client interface byte-codes are interpreted for operation on a particular client platform.

7. The quote configurator as claimed in claim 1 wherein the server interface byte-codes are interpreted for operation on a particular server platform.

8. The quote configurator as claimed in claim 1 wherein the user interface includes a screen display configured for product selection and selection of information indicative of business rules.

9. The quote configurator as claimed in claim 1 wherein the client module further includes an interface to a nomadic user.

10. The quote configurator as claimed in claim 1 wherein the client module further includes an interface to an Internet user.

11. The quote configurator as claimed in claim 1 wherein the client module further includes an interface to an intranet user.

12. A method for configuring quotes comprising:

receiving quote input and command selections from a user via a user interface in a client module, the quote input and command selections including product selection and selection of information indicative of business rules;

sending said quote input and command selections to a server across a server interface, said user interface and server interface being comprised of platform independent byte-codes;

accessing quote data and business rules; and

validating the quote input based on the quote data and the business rules.

13. The method as claimed in claim 12 wherein the sending further includes preparing the quote input and command selections in a platform-independent, usage-independent and access-independent transport protocol for transport to the server.

14. The method as claimed in claim 12 wherein the user interface is a platform-independent, usage-independent and access-independent graphical user interface.

15. The method as claimed in claim 12 wherein the client module is JAVA compatible.

16. The method as claimed in claim 12 wherein the server is JAVA compatible.

17. The method as claimed in claim 12 further including interpreting the client interface byte-codes for operation on a particular client platform.

18. The method as claimed in claim 12 further including interpreting the server interface byte-codes for operation on a particular server platform.

19. The method as claimed in claim 12 further including receiving a product selection and receiving a selection of information indicative of business rules.

20. The method as claimed in claim 12 further including receiving input from a nomadic user.

21. The method as claimed in claim 12 further including receiving input from an Internet user.

22. The method as claimed in claim 12 further including receiving input from an intranet user.

23. On a computer useable medium having computer readable code embodied therein, a client module for causing the computer to configure quotes, the client module comprising:

computer readable program code configured to cause the computer to receive quote input and command selections from a user via a user interface, the quote input and command selections including product selection and selection of information indicative of business rules;

computer readable program code configured to cause the computer to send said quote input and command selections to a remote server across a server interface; and

computer readable program code configured to cause the computer to receive validation information from the remote server indicating whether the quote input is valid based on quote data and the business rules,

said user interface and said server interface being comprised of platform independent byte-codes.

24. On a computer useable medium having computer readable code embodied therein, a server for causing the computer to configure quotes, the server comprising:

computer readable program code configured to cause the computer to receive quote input and command selections from a remote client module across a server interface;

computer readable program code configured to cause the computer to access quote data and business rules; and

computer readable program code configured to cause the computer to validate the quote input based on the quote data and the business rules,

said server interface being comprised of platform independent byte-codes.

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